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THE EAR;

ITS

DISEASES AND INJURIES

AND THEIR

TREATMENT.

BY

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READING, PA.

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PREFACE.

THE great want of a better understanding of the organ of hearing, its ailments and their treatment, is the motive impelling me to place before the public this book. This want is not confined to the laity, but unfortunately is also shared by a large class of physicians, many of whom are reputable practitioners, but failing, for want of time or inclination, to give to this branch of medical science that study and attention to which its importance so justly entitles it, are unprepared to treat the diseases of these organs, or advise properly on this subject. Hence a conviction rests upon the public mind that little can be done in the way of treatment for the relief of deafness or the removal of the causes producing it. Hence too we may account for the fact that *charlatans* enjoy such a liberal patronage from this class of sufferers, who, while they are not at all successful in benefiting such afflicted, are, nevertheless, in consequence of their want of knowledge and skill, quite successful, by their tamperings, in further injuring the organs they attempt to treat, and thereby prejudicing the minds of the people against the treatment of ear ailments.

During the past fifteen years the science of Otology has made commendable progress, and to-day we find this science cultivated by a class of men who are the equals of any in the medical profession; but the fruits of the labors of those engaged in the advancement of this special science have, as yet, not been properly disseminated. The world at large is not yet aware of the great advance in this special department of medical science. It is not enough to advance this science to its present state, and limit the knowledge by technicalities or technical works to the leading minds in the profession, or to those only who devote special attention to this branch of the medical profession, but the primary principles of such knowledge should be disseminated in a plain and comprehensible form, in order that the people may understand and appreciate its present status and abandon their prejudices, and that the afflicted may know and avail of the benefits it confers. To that end this book has been written—*compiled*, chiefly, from the most recent writings of men of eminence and experience, whose names may be found in the Index of Authorities in the front part of this book, and *specially* in connection with the subjects of which they treat, to whom I accord whatever merit this work may possess, not laying any claim to authorship, save in the collection of the material, its general plan and the arrangement of the subjects, together with a portion only of the matter.

I have divided this work into ten parts, as follows: First, Anatomy; Second, Physiology; Third, Hygiene; Fourth, Pathology; Fifth, Examination of Ear Patients; Sixth, The Diseases of the External Ear; Seventh, Diseases of the Middle Ear; Eighth, Diseases of the Internal Ear; Ninth, Unclassified Ailments; Tenth, Artificial Ear-Drums and the Audiphone.

Under these divisions and sub-divisions it has seemed to me the several subjects might be more clearly set forth, and in order that the laity may fully comprehend the meaning of the medical or technical phrases, I have appended a glossary defining all technicalities. Having thus presented my work, I commend the same to the careful perusal and kindly consideration of all who may feel an interest in this special department of medical science.

C. E. SHOEMAKER.

READING, PA., Dec. 13, 1879.

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PART I.

ANATOMY.

ANATOMY.

The organ of hearing is divided into three parts:

1st. The EXTERNAL EAR, which includes the auricle and the external auditory passage, and is separated from the middle ear by the drum membrane.

2d. The MIDDLE EAR, being the tympanum or drum, with its contents, the ossicles (little bones), membranous partitions, the mastoid cells, and the Eustachian tube.

Note.—These two divisions make up the sound-conducting apparatus.

3d. The INTERNAL EAR, called, from its complexity of structure, the *Labyrinth,* consists of the vestibule, semi-circular canals and cochlea, and contains the expansions of the nerve of hearing. This is the "fundamental" or essential part of the organ of hearing—the sound-perceiving portion of the organ.

EXTERNAL EAR.—* "The expanded part of the ear is the *pinna,* or *auricle*; the auditory opening (or canal) is the *external meatus.*

The *pinna* consists of cartilage covered by skin. Its external prominent rim is the *helix.* Parallel with and in front of this, but dividing above, is the *anti-helix.* Within the inclosure of the latter is the cavity of some size, the *concha.* In front of this, over the meatus, is the pointed projection, the *trayus*; and opposite to the latter a smaller one, the *anti-trayus.* The softer lowest part of the ear is called the *lobule.*

The *external meatus* or auditory canal is about an inch and a quarter long, and directed forwards and inwards, slightly curved. At its end or bottom is the membrana tympani or drum-head. The meatus is formed partly of cartilage and partly of bone, and is lined with a thin skin. Near the orifice are hairs and sebaceous glands; and further in the *ceruminous* glands, which secrete the ear wax."

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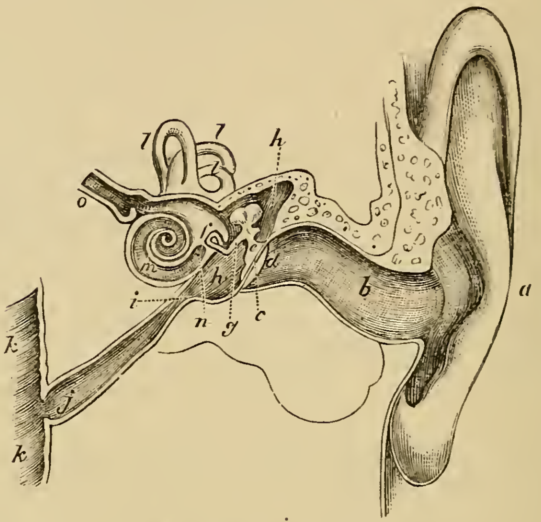
* Hartshorn's Conspectus of the Medical Sciences, page 203.

Fig. 1.



STRUCTURE OF THE EAR.

a, auricle (left ear); *b*, external auditory passage; *c*, membrana tympani (section); *d*, insertion of membrana tympani in bony canal; *e*, insertion of malleus in membrana tympani; *f*, base of stapes, inserted in the fenestra ovalis; *g*, incus, joining stapes and malleus, and completing the chain of ossicles; *h*, cavity of the tympanum; *i*, Eustachian opening of tympanum; *j*, throat opening of Eustachian tube; *k*, posterior part of throat; *l*, semicircular canals; *m n*, cochlea; *o*, trunk of auditory nerve.

Membrana Tympani.—"The anatomy of the membrana tympani," (drum-head,) says Prof. Allen,* "should be well studied and known, because in it will be found characteristics of disease and changes from the normal condition sufficient to form a very large proportion of cases of deafness. Sir William Wilde says fully three-fourths; others give still a larger number.

The anatomist, who obtains his knowledge of this structure from *post-mortem* examinations or from dried preparations only, can have no very clear idea of its condition during life; for its delicacy, its fine epidermic covering, transparency, curvature, colour, and lustre, are all more or less destroyed or altered in the dead. The descriptions of the membrane which you might meet with in anatomical text-books are, on this account, mostly untrustworthy and insufficient for the requirements of the aural surgeon.

---

* Allen, Aural Catarrh and Curable Deafness, page 40.

The membrana tympani may be described as a thin elastic membrane, stretched obliquely across the further end of the external auditory canal in such a way as to form an acute angle with the lower wall, and an obtuse angle with the upper wall, of the latter. It is inserted into an osseous groove, which is not quite complete above. We have to notice, separately, its *relative position*, *inclination*, *form*, *size*, *colour*, *curvature*, *lustre*, *degree of transparency*, and *texture*; for in all these particulars are variations perceptible in disease. My description will be as brief and condensed as possible.

As regards *relative position* of the membrane. If examined on the outer side, we first remark the handle of the malleus, extending as a whitish yellow stripe from the upper border downwards and backwards very nearly as far as the centre, where it somewhat expands and is flattened. This *manubrium* (erroneously called by Toynbee and others the long process), inclines inwards towards the cavity of the tympanum, and divides the membrane into two rather unequal parts, the anterior and posterior, of which the first is slightly smaller than the other. We may assist our idea of the inclination of the manubrium of the malleus, by dividing the membrane into four quadrants.

In the anterior upper fourth at the centre of the periphery we see the very projecting, small white rounded tubercle, the short process (*processus brevis*), to which the neck of the malleus and the tensor tympani muscle are attached on the inside; then the handle, curving downwards towards the centre between the fibrous layers of the membrane, draws it inwards and arches it in such a manner that it presents a concavity, and thus is determined what is called the curvature of the membrane. This curvature is greatest towards the lower end of the handle, and is termed the *umbo* or umbilical contraction. Although the membrane, as a whole, is thus made concave externally by the traction of the malleus handle, we shall upon closer examination perceive that it nevertheless exhibits a tolerably well defined convexity in some parts, especially at the anterior and lower portion. This is somewhat difficult to understand, and still more so to describe; but this peculiar arrangement will account for the many variations in the form of the little *cone of light*, or triangular reflection, which is visible in certain movements of the membrane during air-pressure alterations, in inflation or catheterisation from within, and in disease. The short process of the malleus produces at the upper-anterior quadrant a decided bulging outwards, from which generally proceed two folds, the shorter running forwards and the longer backwards.

The *inclination* of the membrane is also difficult to understand. In the fœtus and young children, the tympanic ring into which the membrane is inserted like a watch-glass into its case, lies nearly horizontal with the meatus, and though it gradually approaches a more vertical direction in the adult, yet the amount of its inclination varies much in different individuals. Our judgment of its size or superficial area is modified by this inclined position. If it be very oblique to our axis of vision, it appears to us smaller than in reality, being of course seen in perspective, or foreshortened; and the less the inclination, the larger does the membrana tympani appear to us. The inclination is relative to the walls of the external meatus, and the measurements of the angles thus formed have been variously stated, but I think it may be estimated that the membrane forms, with the upper wall, an obtuse angle of about 140, and with the lower, of course an acute angle of 40 degrees.

The *form* of the drum-head varies with the diameters of the osseous meatus, and in different individuals. In the child it is nearly circular, in adults more oval, sometimes irregularly heart-shaped, owing to the interruption in the surrounding osseous ring.

The *size* likewise varies in accordance with the form and size of the osseous ring. In the fœtus, the size of the membrana tympani bears no proportion whatever to the body, since it has nearly completed its growth at birth, and mostly afterwards only increases in length. In the adult its average vertical diameter is between 9 and 10 millimetres, and its horizontal diameter about 8 or 9.

The *colour* of the membrane must in truth be studied on the living subject, as maceration after death alters it considerably.

Hence the discrepancies between the accounts in various text-books. Another source of disagreement lies in the differing methods of investigation adopted by authors: the age of the subject, the kind of light used in the examination, the degree of transparency of the membrane, and its inclination to the auditory canal, are all elements which go to make up the colour, and greatly influence it. Nor can we, properly, speak of the membrane as a whole, since the different parts of it are, with the same light, differently tinted. In what may be characterised as a normal condition of the membrane, the colour viewed in ordinary daylight, most nearly approaches a *neutral grey*, mingled with a deeper tint of violet and light yellowish-brown. The grey is darker at the anterior portion than at the posterior. When the membrane is transparent it has a yellowish-grey colour, near its centre, at the end of the manubrium of the malleus, and a little behind it, on account of the yellow rays reflected from the promontory. In some very rare cases of transparency and thinness, the long process of the incus and even the posterior crus of the stapes, may be distinctly seen. In children, the dermoid layer on the outside, and the mucous membrane on the inside, are both of them thicker than in adults; and hence the membrane appears of a darker grey and duller, and the promontory is rarely seen through it. In old age it is less translucent, whiter, and lustreless.

Curvature and Lustre.—Differences in inclination and curvature affect in many ways the lustre of the membrane. We have noticed its peculiar form, and that as a whole it is concave externally; but from the deepest point of its concavity (the umbo) towards the circumference, it curves somewhat forwards, and is slightly convex. Now, in healthy membranes, in addition to the general lustre extending over the whole surface, there is always to be seen a remarkable spot of bright light upon the anterior inferior quadrant. This 'speck of light' (the 'Lichtkegel,' or 'cone of light,' of the Germans) was first described by Sir William Wilde. It is triangular in form, having its apex at the end of the malleus handle, and its base towards the lower and fore part of the membrane, near its periphery.

A knowledge of all the variations in the position of this cone of light is of the utmost importance, inasmuch as its form and size not only indicate alterations in the membrane itself, but also the state of the Eustachian tube, whether freely pervious to air or not. You constantly perceive that I draw your attention to the alterations of this spot when examining a patient. For instance, while the attempt is being made to force air into the tympanum by the Valsalva experiment, or when during the act of swallowing with nostrils closed the internal pressure is lessened, we become assured that the tube is open, if we clearly see the cone of light change its form. It will be found that in the greater number of cases this triangular reflection is broader at the base when the drum-head is pressed outwards, and smaller when it is drawn inwards by rarefaction of the tympanic air. Sometimes you see it as a circular spot in other parts of the membrane; sometimes divided, or striped; and occasionally it is altogether absent. As surely as there is any abnormal change in the curvature or lustre of the membrana tympani, so surely does this little triangular spot vary in form; and so far, its appearance is of great diagnostic value.

As the *lustre* of the outer surface of the membrana tympani depends upon the healthy state of the epidermic layer, there is a general loss of it when the delicate transparent cells of the epidermis are thickened, macerated, or infiltrated. The cone of light, both in the living and dead subjects, may therefore be compared in its appearance to the reflected light from the cornea. Different views prevail among authors respecting the cause of this light spot; but Politzer has, I think, correctly explained it. He says:—'The chief cause is the inclination of the membrane to the axis of the auditory canal, together with the concavity of the membrane produced by the action of the malleus.' He carefully prepared a healthy tympanic membrane with the auditory canal removed, leaving it attached only to the bony ring around it. He turned it about so that other portions of the drum-head were successively brought into the position of the original cone of light; and he then found that every one of these points showed a reflection of light which varied only in degree from the usual form of light spot. You may convince yourselves of the correctness of Politzer's opinion by stretching any glistering animal membrana over a large ring, and giving it the inclination of the membrana tympani. If you then hold the mirror relatively as you do in examining the drum-head, you will perceive no reflection; but if the central portion be drawn in by pressure or traction, the reflection will be immediately seen at the exact spot corresponding to where the cone of light is formed on the membrana tympani.

TRANSPARENCY.—From the absence of the usual transparency arising from the opacities of the membrane, we can scarcely draw conclusions as to the nature of the lesions which may have produced the change. Sometimes it may have been caused by morbid processes on the external surface which have run their course, and resulted in complete recovery; in other cases, a catarrh of the tympanic cavity has passed off, leaving the mucous layer opaque, but has not impaired its function.

TEXTURE.—Turning now to the histology of the membrana tympani, we find it to consist of three layers,—a middle fibrous (*lamina propria membranæ tympani*), an external dermoid, and an internal mucous layer; these latter being the two coverings which it receives from the meatus and from the cavity of the tympanum respectively. The *dermoid* layer is an extremely delicate continuation of the lining of the meatus, and consists of very transparent epidermis, and the elements of the cutis in which the blood-vessels and nerves ramify. In inflammation these vessels give the red appearance, and the exquisite sensibility or extreme pain when inflamed depends upon the supply of nerves to the same layer.

It was formerly thought that the fibrous layer secreted the epidermis, and the existence of this cuticular layer now accounts for various phenomena in certain diseases of the ear which the surgeon could not previously understand. The proper middle *fibrous* layer can be easily separated into two laminæ, which are named from the arrangement of their component fibres, an outer *radiating* and an inner *circular* set.

The outer radiating fibres run from the cartilaginous ring which is inserted into the osseous groove of the temporal bone (before spoken of), to the handle of the malleus. They slightly increase the thickness of the membrane towards the centre, because here their fibres are more closely packed together; while the thinner are on the posterior part of the membrane between the circumference and the handle. The inner or circular layer of fibres are arranged, as their name implies, in concentric circles. They are very strong and firm at the circumference, but at the centre so attenuated as to be scarcely perceptible. This layer is very intimately connected with the mucous membrane, and is nourished by it. The handle of the malleus lies between the radiate and circular fibres, and is inserted (as it were) through a slit in the latter; so that the uppermost rings of them are anterior and external to the neck of the malleus; while the lower and larger portion of them are posterior and internal, thus surrounding the neck like a ruffle. Grüber states (and for reasons to be assigned later, I think correctly), that there is a complete articulation between the cartilaginous structure at the circumference of the membrane, and the malleus; that they are separated by an epithelial layer; and that there is a synovial fluid between them.

The *mucous* layer is a continuation of the mucous membrane of the tympanum, and, in a healthy state, is extremely thin, consisting almost entirely of a single layer of pavement epithelium; but it is very frequently indeed subject, in aural catarrh, to pathological changes, which soon thicken it. There are plenty of blood-vessels in the mucous membrane, but few or no recognisable nerves. It differs greatly in this respect from the external cutaneous layer derived from the meatus; and this fact coincides with our practical experience before referred to, that superficial and external inflammations of the membrana tympani are always painful, while the greatest changes may occur in the internal or mucous layer without the patient's suffering any pain whatever in the ear. You cannot over-estimate this circumstance.

THE BLOOD-VESSELS OF THE MEMBRANA TYMPANI.—There are two sets of vessels derived from two distinct sources, and they are completely separated from each other, except at the circumference of the non-vascular fibrous structure (the *lamina propria*) where they freely anastomose.

The external vascular net-work of the drum-head belongs to the outer cuticular layer, whilst the inner belongs to the mucous membrane of the tympanum (the mucous layer). The external plexus is derived from the deep auricular branch of the external carotid (the *arteria auricularis profunda*). These vessels extend themselves from the upper wall of the auditory canal upon the membrana tympani, and radiate upon its periphery, so as to form a complete wreath by uniting there with the vessels from the tympanic cavity. Some of the branches run down the centre of the membrane, and often-times are visibly filled with blood when we syringe the ear with warm water, or when the patient inflates.

The inner vascular net-work arises from the vessels of the tympanic cavity. It is smaller, and is more of a capillary system than the outer. The plexus is derived from the tympanic branch of the stylo-mastoid, and freely anastomoses with the deep auricular artery (which comes from the internal maxillary) on the circumference of the membrane, particularly at the upper deficiency of the tympanic ring, forming with these external branches the circular plexus which gives the vivid red appearance to the membrane in acute inflammation.

One or two arteries run along the handle of the malleus, and deserve especial notice. Occasionally, when I am in doubt as to the position of the malleus, owing to opacity, &c., of the membrane, I am guided to its handle by the red line or lines coursing downwards on it or parallel with it. You will scarcely ever fail in making this manifest by directing the patient to attempt to inflate the drum; for whether he succeeds or not, the straining will cause turgescence of the vessels of the membrane, and trace out the course of the manubrium.

THE NERVES OF THE MEMBRANA TYMPANI.—The nerves are chiefly, if not wholly, to be found in the cuticular layer. The tympanic nerve is a branch of the superficial temporal or auriculo-temporal, which comes from the sensory part of the third branch of the fifth; and it is this connexion which causes the great sensitiveness of the outer surface of the membrane. Nerves have not satisfactorily been made out to ramify either in the fibrous or mucous layers, but the external cuticular layer of the membrane has numerous small branches derived from the same important inferior maxillary, or third division of the *trigeminus*, as that which supplies the tensor tympani. This common origin of the nervous supply to the muscle which moves the membrane, and to the surface of the membrane itself, is very suggestive. I think it supports the view that the reflex action of the muscle under the stimulus of certain sounds, is due to the nervous power imparted both to muscle and membrane, by this compound nerve."

MECHANISM OF THE MEMBRANA TYMPANI.—*"The membrana tympani is to be considered as a tense membrane, which, however, differs essentially from those which have been hitherto studied in acoustics, in the fact that it is curved. Its tension is modified by the handle of the hammer which draws it inward, and which is itself retained in this position by means of ligaments of attachment, and by the elasticity of the tensor tympani. If the radial fibres of the membrana tympani were not united by transverse ones, they would be stretched in a straight line. In point of fact, however, they maintain a curved shape with the convexity looking toward the meatus; hence we conclude that the radial fibres are drawn toward one another by circular fibres, and that the latter are also made tense at the same time. There is, in fact, in the membrana tympani at rest no other force capable of holding the radial fibres in a curved position, except the tension of the circular fibres.

In the concussions which sound produces, the pressure of the air acts sometimes upon the convex, sometimes upon the concave surface of the membrana tympani, according as this pressure is alternately greater or less in the meatus than in the cavity of the tympani; in every case the pressure of the air acts perpendicularly upon the membrane, also perpendicularly upon the curve formed by the radial fibres, which curve it at one time increases and at another diminishes. Since the curves formed by the radial fibres of the membrana tympani are only slight, therefore, as will be shown afterward, the mechanical operation is the same as if the pressure of the air were exerted at the end of a very long lever-arm, while the tip of the manubrium represents the end of a very short lever-arm. A relatively great displacement of the surface of the membrana tympani in the same direction as the pressure of the air necessitates a comparatively small displacement of the point of the hammer, and *vice versa*. Hence, in accordance with the well-known law of virtual velocities, a relatively small amount of pressure of the air will counterbalance a comparatively strong force acting at the handle of the hammer—in other words, it will supply an equivalent force."

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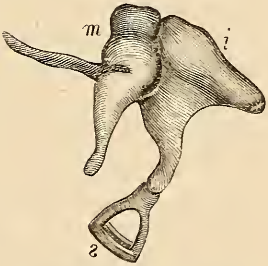
*Mechanism of the Ossicles of the Ear, by Prof. H. Helmholtz of Berlin, Prussia. Translated by Albert H. Buck and Normand Smith, of New York, page 53.

Middle Ear or Tympanum.—* "Being within the petrous portion of the temporal bone, the cavity of the tympanum or drum is separated from the external meatus by the *membrana tympani.* It communicates (in front) with the pharynx by the Eustachian tube, and behind, with the *mastoid cells.* Within it are the *ossicles* or small bones of the ear; *malleus, incus, orbicular* and *stapes.* The *malleus* or hammer-bone has a head, neck, handle or *manubrium* and two processes. The head is the oval upper extremity, which connects with the incus. The manubrium is vertical in position, and is attached along its margin to the membrana tympani. The *processus gracilis* is long and delicate; it gives origin to the laxator tympani muscle. The *processus brevis or short process* gives *origin to the tensor* tympani muscle. The *incus* or anvil-bone has an irregular four-sided body, and a long and short body, and a long and short process. The body joins with the malleus. The long process connects with the osorbiculare.

Fig. 2.



OSSICLES OF THE EAR.
m, Malleus; *i*, Incus; *s*, Stirrup.

The *stapes* or stirrup-bone has very much the shape of a stirrup. By its head it is attached to the orbiculare; by its foot to the *fenestra ovalis* of the vestibule. To its neck is connected the stapedius muscle.

The *orbiculare* is a very small round bone, between the long process of the incus and the head of the stapes. These bones are all united by ligaments, admitting of slight movement."

The Movements of the Stirrup.—† "The joint of the anvil and stirrup resembles the flat segment of a sphere which is convex toward the stirrup. The capsule is soft, and interwoven more with elastic fibres than the two other articulations; on its inferior

* Hartshorn's Conspectus of the Medical Sciences, page 203.

† Helmholtz, Mechanism of the Ossicles of the Ear. Translated by Albert H. Buck and Normand Smith of New York, page 41.

side there are compact fibres which, when the anvil is drawn upward, are put on the stretch and carry the anvil with them, but when the reverse movement takes place, are folded together so that the anvil does not follow so closely as before.

The base of the stirrup is surrounded by a lip of elastic fibro-cartilage resembling the lips of cotyles and of larger articulations; it has a breadth of 0.7 mm. The union between the base of the stirrup and the wall of the labyrinth appears to be formed by means of the periosteum of the vestibule, which periosteum is extended over the base of the stirrup. The fibrous lip of the stirrup is not attached to the sides of the fenestra ovalis.

The mucous membrane of the cavity of the tympanum extends also over the outer side of the joint. The attachments of the base of the stirrup along its straight edge are more tense on the inferior than on the superior surface, and most compact at the posterior end. Now, if you apply a pin to that side of the base of the stirrup which is toward the vestibule and press it outward, it will, though separated from the anvil, make at the same time a lever-like movement by which its head is pushed downward and backward. If you employ a fine sewing-needle as a *lever of sensation* and press it into the base of the stirrup, the lever-like movement can be still better observed. In other respects the mobility of the base of the stirrup is very slight. I have calculated it partly by direct observation and partly from the movement of the water of the labyrinth. For the purpose of direct calculation I employed a preparation in which the cavity of the tympanum and the vestibule had been opened from above.

The preparation was held firmly in a vice in such a position that the base of the stirrup looked downward. The point of a fine sewing-needle was then inserted into the membrana obturatoria, near the anterior limb of the stirrup; the needle had for its second fulcrum the sharply cut edge of what remained of the osseous wall between the cavity of the tympanum and the labyrinth. This point, 3.8 mm. removed from the point of the needle which was fixed in the ligamentum obturatorium, served as the centre of motion for the lever-like movements. The free portion of the needle, which was horizontal, formed the second longer arm of the lever, (length, 23 mm.). The point of this longer arm moved backward and forward

0.20 mm., when the stirrup was pressed inward and outward by means of a needle applied to its base; and .15 mm., when the pressure was made by condensing and rarefying the air in the external meatus, whereby the movement of the membrana tympani was transmitted through the other bones of the ear to the stirrup.

Now, since the movements of the stirrup seem magnified, at the free end of the needle, $\frac{23}{3.8}$, therefore the displacements of the stirrup itself amount in these cases only to 0.033 and 0.025 mm. After frequent repetition of the experiment, by which the ligaments were thoroughly stretched, the amplitude of displacement increased to 0.056 mm. In another preparation only the superior semicircular canal of the labyrinth was opened, according to Politzer's plan, from the upper side of the temporal bone. Into the opening thus made was inserted a slender glass tube, whose transverse section was found, by calibration with quicksilver, to be 0. 228 of a square millimetre. The vestibule and a portion of the tube were filled with water.*

The movements of the bones of the ear produced by forcing air into the external meatus caused the fluid in the tube to rise 0.9 mm. Now, since the diameters of the fenestra ovalis were found equal to 1.2, and 3 mm., therefore the surface of the fenestra ovalis is nearly 12.4 times as large as the transverse section of the glass tube. The mean amplitude of the excursion of the base of the stirrup must then be $\frac{1}{12.4}$ of that of the fluid in the tube which is 0.0726 mm. According to the highest calculation, the excursions of the stirrup amount to $\frac{1}{18}$ and $\frac{1}{14}$ mm.

The relation of the stirrup to the anvil is such that if the handle of the hammer be drawn inward, the long process of the anvil presses firmly against the knob of the stirrup; the same takes place if the capsular ligament between both be cut through.

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* In order to render it air-tight, I first dried the bone as much as possible with blotting-paper; then I applied a red-hot iron wire to the margin of the opening in the semi-circular canal, and upon this spot I placed immediately a drop of hot cement made of wax and resin; in this the glass tube was fastened. Finally, the preparation was set in a bowl of water of sufficient depth to cover the free end of the glass tube, and then the whole was placed under the air-pump. On exhausting the air in the chamber, the air in the vestibule escaped through the tube, and then water took its place.

If the manubrium be moved outward as far as the ligaments of the hammer will allow, then, in case the capsular ligament be cut, the long process of the anvil will recede from $\frac{1}{4}$ to $\frac{1}{2}$ mm. from the stirrup. With this position of the hammer, if the handle of the anvil be pressed back against the stirrup, it will remain in this position without springing back; at the same time the cogs of the joint of the hammer and anvil become separated entirely, and there is no force present sufficiently powerful to draw the anvil back. In the normal condition of the articulation of the anvil and stirrup, the point of the handle of the anvil remains always attached to the stirrup; but it follows, from the already-mentioned facts, that the anvil exercises no strain upon the stirrup when the handle of the hammer is driven outward, since the handle of the anvil, even when the articulation is severed, can remain in contact with the stirrup without being drawn outward with the handle ot the hammer.

This arrangement has its important result, namely, that by means of an increase of pressure in the cavity of the drum or diminution of pressure in the meatus, the membrana tympani and the hammer can be perceptibly driven outward without the stirrup incurring the danger of being torn from the fenestra ovalis. The membrana tympani serves as a very powerful restraint to the reverse movement of the hammer.

Since the point of the long process of the anvil, seen from the axis-band, is inclined still further backward than the point of the handle of the hammer, therefore the former rises when pressed inward more than the latter, and the elevation is not entirely compensated for by the slight depression of the hammer already mentioned; in short, the driving of the membrana tympani inward causes the point of the head of the hammer to be driven outward and at the same time slightly elevated.

This agrees with the corresponding movement of the stirrup, whose knob-like head rises slightly when the stirrup is pressed inward in consequence of its unequal attachment to the upper and lower border of the fenestra ovalis. This lever-like movement has already been observed and described by Henke,* Lucae,† and

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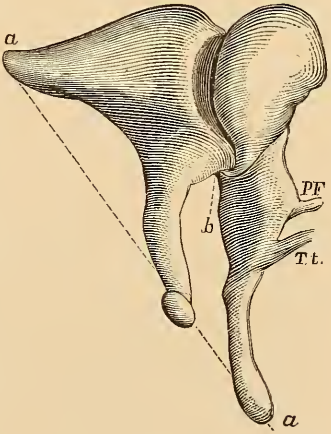
* Der Mechanismus der Gehorknochelchen, in der Zeitschrift fur rationelle Medicin. 1868. † Archiv fur Ohrenheilkunde. Vol. iv. pp. 36, 37.

Politzer.* In reply to the first, I will only remark that the lever-like movement of the stirrup is by no means its only one; that 'perhaps' one border of the plate of the stirrup is not moved inward while the other moves outward. Looking at the base of the stirrup from the vestibule, we can much more easily recognize the fact that both borders are driven outward and inward simultaneously; the superior, however, more than the inferior.

The apparent discrepancies between the observations of Lucae and Politzer, in respect to the effect which an increased pressure of air in the cavity of the tympanum has upon the stirrup and the water of the labyrinth, are to be explained by supposing that Lucae observed the lever-like movement of the stirrup, and Politzer the oscillation which takes place in the water of the labyrinth when the stirrup is pressed inward. Neither is it always necessarily in the same degree; at least not in this case, because the pressure of the air through the fenestra rotunda can also cause increased pressure in the labyrinth.

THE CONCERTED ACTION OF THE BONES OF THE EAR.—If we suppose the hammer and anvil so united that their cogs press against one another and both move like one compact body, exerting a pressure upon the point of the handle of the hammer, which is continued inward and transmitted from the anvil upon the stirrup, then the system of the two ossicles can be considered as a one-armed lever whose fulcrum lies where the point of the short process of the anvil presses outward against the wall of the cavity of the tympanum. The tip of the handle of the hammer represents the point of pressure, and the point of the handle of the anvil the other point which resists this pressure. These three points lie in fact very nearly in a straight line, so that the point of the anvil and stirrup recedes

FIG. 3.



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* Wochenblatt der K. K. Gesellschaft der Aertze. Wien, 1868.

only very slightly inward from the straight line of union between the tip of the handle of the hammer and the outer side of the articulation of the anvil with the tympanum. This can easily be seen in preparations where the natural union of the bones is still preserved. Fig. 3. represents both bones in the position where their cogs are attached to one another; *a a* is the straight line which passes through the three points mentioned above; *P. F.*, the stump of the processus Folianus; *T. t.* the tendon of the tensor tympani; and at *b* we have the cog of the anvil. In this preparation I found the entire length of the lever to be 9½ mm., the shorter arm between the two points of the anvil 6⅓ mm., so that the latter is ⅔ of the length of the longer arm. Hence, when the hammer and anvil lie close together, the excursion of the tip of the handle of the anvil will amount only to ⅔ of that of the handle of the hammer, but the amount of the pressure which the former exerts upon the stirrup will be 1½ times as great as the force which is exerted against the handle of the hammer.

Since the three points of the lever lie in a straight line, therefore the pressure is quite independent of the position of the remaining parts of the ossicles—presupposing only that the latter maintain a position in which the articular surfaces press firmly against each other.

The result will be obtained in the following manner: While the membrana tympani is being driven inward, the hammer will rotate about an axis which is inclined obliquely (°30) toward the plane of insertion of the membrana tympani, and its head will recede from the tympano-incudal joint, thus putting the malleo-incudal capsular ligament on the stretch. Now, since every attempt to rotate the ossicles in such a manner that the cogs will press against each other, produces instantly a considerable separation of the articular surfaces, therefore the already tense fibres of the capsular ligament serve to resist any force capable of producing this result. On the other hand, if the membrana tympani be driven outward, the capsular ligament becomes relaxed and yields to such an extent as to allow of a slight separation of the articular surfaces, like that which happens when the cogs are separated. The remaining displacements, which the malleo-incudal joint admits of, do not cause the above-mentioned three points of the lever to depart from the straight line. One of the axes of rotation of this saddle-shaped joint passes through the tip of the handle of the hammer; the other is perpendicular to the plane which passes through the three points and the articulation, and consequently separates the long process of the anvil from the handle of the hammer.

In the above-mentioned experiments, where, as a general thing, the stirrup has been set in motion by exerting pressure upon the hammer or upon the membrana tympani, we have seen that the amplitude of the excursion becomes slightly diminished, that is, to about $\frac{2}{3}$ of its magnitude. In order to determine the firmness of the mechanism I tried the reverse experiment and endeavored to measure the extent of the excursion of the hammer by pressing the base of the stirrup outward and thus setting the hammer in motion. In this case, of course, the only movements of the hammer to be taken into consideration are those which cause it and the anvil to remain in close contiguity at the point of contact. (The preparation used in this experiment has already been described as having a tube inserted into the vestibule.) Having cemented a glass thread 59 mm. long to the head of the hammer, I endeavored to find how much motion could be produced in the hammer by alternately forcing fluid through the glass tube and then withdrawing it from the same. The excursion at the tip of the glass thread amounted only to about $\frac{1}{2}$ mm. If 4 mm. be the distance from the axis of rotation to the point where the glass thread is fastened to the head of the hammer, then the length of the lever is 63 mm. and the above-mentioned excursion of $\frac{1}{2}$ mm. corresponds to a rotation of about half a degree. For the tip of the handle of the hammer, whose distance from the axis-band amounts to $4\frac{1}{2}$ mm., this gives, on the other hand, an excursion of only $\frac{1}{28}$ mm., an amount which is about the same as the mean value of the excursion of the base of the stirrup. Theoretically we should expect a somewhat greater value for the excursion of the handle of the hammer. Taking into consideration the diminished tension of animal tissue after death, and the want of elasticity, namely, of the tensor tympani, we cannot well expect in the united action of the bones of the ear the same precision which we find in the living subject. In this way the transmission of the light movements of the anvil to the hammer may be impaired.*

These different attempts at measurement coincide thus far in showing that the displacements of the stirrup and hammer, as long as the two remain firmly connected, are limited to amplitudes each of which is smaller than a tenth part of a millimetre.

On the other hand, if we put the hammer in motion by forcing air into the external meatus and then withdrawing it, the glass thread attached to the ossicle indicates much greater excursions; its point moves backward and forward 5 mm., while before (as already mentioned) it experienced, in a direction from the stirrup outward, only a displacement of $\frac{1}{2}$ mm.

The excursion which the hammer can make without the anvil is nearly nine times as great as that which the two together can accomplish. This kind of movement is not transmitted to the water of the labyrinth, excepting of course the slight changes in pressure which the changed tension of the articular ligaments, or the rubbing of the articular surfaces of the malleo-incudal joint upon one another, are perhaps sufficient to produce in the water of the labyrinth when the cogs of the articulation are no longer in contact. If you force air into the cavity of the tympanum of your own ear, you will hear feeble tones issuing from the middle and upper portions of the scala, almost if not quite as distinctly as usual; on the other hand, it is very apparent that we hear the same tones, when they are given forcibly, much more distinctly when the pressure in the cavity of the tympanum is uniform than when it is increased. This, I think, shows that the articular surfaces of the hammer and anvil can adhere together and be firmly united by means of motion on one another, similar to that which takes place in anatomical preparations when the joint of the anvil and stirrup has been cut through and the rarefaction of the air in the meatus auditorius has caused the hammer to be drawn outward. The anvil then is also drawn outward; but if we turn it by means of a needle, so that its long process again touches the stirrup, it will, as mentioned above, still remain fixed in this position. Friction will also cause the anvil to adhere firmly to the hammer in the position already given, in opposition to the tension of the ligaments, or any other mild forces, and that too when the vibrations of sounds are feeble. More powerful forces or concussions will of necessity cause the two bones to slide upon one another, and strong vibrations of sound in such a position of the bones will be very perceptible.

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* I will remark in this connection that the transmission of the movements of the membrana tympani to the water of the vestibule was also perceptibly impaired at the time when I made the above described experiment. I obtained only 0.4 mm. elevation in the manometer, whereas, on the day before, when I had filled the vestibule with water under the air-pump, the elevation amounted to 0.9 mm. It is to be hoped that some anatomist, who has an abundance of suitable preparations at his command, will repeat these experiments. Of course the specimens should be as fresh as possible.

I have used in these experiments a watch and a tuning-fork; striking the latter lightly, I held it so far from the ear that the beats, which the rotation of the fork upon its long axis produced, were still perceptible. We hear them just as distinctly when the membrana tympani is distended, provided they belong to the upper octaves of the scale, and very nearly as distinctly in the middle octaves. The deeper tones are, of course, considerably weaker. On the other hand, a tuning-fork of a higher pitch, when struck forcibly and held before the ear while the membrana tympani was distended, showed a very perceptible crescendo, just as we restored the equilibrium of the air by the motion of swallowing.

I wish to call attention, in this connection, to another phenomenon whose explanation, I think, can be deduced from the mechanism already described. If we take a tuning-fork which consists of a single piece of steel, and which therefore has nothing about it which can give a rattling sound, and, after having struck it forcibly, hold it near the ear so that the sound can be heard very distinctly, the character of the tone becomes sharp, and we hear distinctly jarring sounds similar to what is heard in musical instruments when something is loose, or from a tuning-fork when pressed rather lightly upon a sounding-board. These jarring sounds result from the slight shocks which a vibrating body makes upon a body at rest or vibrating in a different manner. These blows are repeated regularly and produce sound; but inasmuch as they correspond to an interrupted periodical movement, the sound possesses very many overtones and is harsh in character. Such tones occur, as is well known, in the ear itself as the result of very loud sounds. We can hear also from a *B* tuning-fork of 116 vibrations a jarring sound so distinctly that it resembles a buzzing in the ear. This jarring tone is very distinct and strong when the pressure of the air in the cavity of the tympanum is equal to or less than that of the atmosphere, and when the cogs of the hammer and anvil are closely united; but it disappears when the air is driven into the cavity of the tympanum and the cogs are consequently separated. I think, therefore, that we are justified in concluding that this jarring tone is caused by the cogs.

When the excursions of the membrana tympani are very great, and during the outward phase of the vibration, the anvil is not driven outward with any considerable force, and cannot therefore follow perfectly the excursions of the hammer; the result of which is that they are separated, and that during the next vibration inward the anvil receives a blow from the returning hammer. This mechanism is also well adapted to the production of combination tones,* and the peculiar sensation of buzzing in the ear resulting from the combination tones of two strong soprano voices, when thirds are sung, can, I think, be referred to this jarring which takes place between the hammer and anvil.

This phenomenon is also of great importance in its relation to the sensation which harmony produces in the ear, since strong tones which take place outside of the ear, and without overtones, must of necessity develop harmonious overtones in the ear. In this way sounds with harmonious overtones, which correspond to a regular periodical movement of the air, acquire a natural preference over those with unharmonious overtones, especially as the whole doctrine of conferences becomes, through this circumstance, independent of the overtones connected with external sound. The jarring tones can be much deeper than the exciting tone, if the vibrating body falls back only after the expiration of the vibrations, and hence receives another blow.

To this class, I believe, belong also certain deep, harsh sounds which we hear when the shrill high notes of the upper octave ($a_4 - g_4$) are sounded very distinctly. It is probable that an unusually strong vibration is produced at the same time in the surface of the membrana tympani, judging from a certain buzzing, tickling sensation which is felt in the deep parts of the ear."

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* Vide Lehre von den Tonempfindungen, pages 233–236.

*" Besides the *fenestra ovalis*, there is another aperture, the *fenestra rotunda*, from the tympanum into the cochlea of the internal ear. The latter is closed by a membrane.

The *muscles* of the tympanum have been already named; *tensor tympani, laxator tympani*, and *stapedius*. The first of the three is the largest. It draws the membrana tympani inwards, making it more tense. The *laxator* reverses this action."

"† In regard to the question when the tensor tympani contracts, I would confirm in this place the recently published observation of Politzer, that it occurs during the act of yawning. Before hearing of his experiments, I had already noticed that whenever I attempted to restrain the motion of the jaws during the act of yawning, I would first hear the well-known snapping noise, indicative of the opening of the tube; then, at the acme of the yawn, I would notice, in addition to the sense of tension in the ear, a loud muscular noise, greater even in intensity than that produced by the most powerful contractions of the masticator muscles during closure of the meati, and certainly greater than when the meati are open. All sounds from without appeared at the same time to be muffled. From these observations I concluded that contraction must have been excited in a muscle whose oscillations are communicated to the organ of hearing with far greater distinctness than those of any other muscle: I refer to the tensor tympani."

*" The *chorda tympani* nerve leaves the facial to enter the tympanum, and crosses its cavity to an opening near the Glaserian fissure. Several other nerves enter and communicate in the tympanum."

THE MUCOUS MEMBRANE.

The Mucous Membrane lining the cavity of the tympanum throughout is very thin, delicate, and smooth. It is spread over every surface, is reflected round the little bones, ligaments, tendons of the muscles and nerves, it covers the internal surface of the membrana tympani, and the membrane of the fenestra rotunda. It extends into the mastoid cells, and is continuous through the Eustachian tube, with the great gastro-pulmonary mucous membrane; possessing thus an extensive and intimate superficial connection with the respiratory and digestive organs. We can well understand, therefore, how in derangements of almost any, even remote parts of the internal surfaces, morbid impressions may be conveyed either by sympathy or continuity of tissue, to the centre of the ear, and there develop symptoms which may considerably impair the function of hearing. It is in this manner that bronchitis, catarrh, cutaneous affections, or dyspepsia, may (by their ill effects upon the mucous surfaces) become the cause of deafness.

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* Hartshorn's Conspectus of the Medical Sciences, page 204.

† Helmholtz, Mechanism of the Ossicles of the Ear, page 41.

The mucous membrane itself is extremely delicate, and has minute epithelial cells on its surface, some of which are ciliated. In fineness and smoothness of texture it approaches the characters of a serous membrane, and from its tenuity, is so transparent that the nervous filaments upon the promontory are distinctly seen, as well as the crura of the stapes and their connection with the base. In children the membrane is highly vascular, but with adults its colour in a healthy state, is a whitish-gray, and polished. Like all mucous tissue, it secretes mucus, but in so small a quantity, and so thin, that it is scarcely perceptible, and so can find a ready outlet through the Eustachian tube. It is necessary to know that the condition of the tympanum is very different in the fœtus and for some time after birth. The cavity is filled, not with air, but with a "cushion of mucous tissue" (Virchow), which swells out from the labyrinth wall to the membrana tympani upon the inner surface of which it rests. This anatomical fact, as well as almost daily practical experience, proves how favourable to the development of inflammatory affections is the condition of the middle ear in children. Ear-ache is of such common occurrence that scarcely a child escapes it at one time or another, and examinations have abundantly shown that it depends upon catarrhal inflammation of the tympanum, or of the adjacent surfaces of the membrana tympani and external meatus.

THE EUSTACHIAN TUBE.

The Eustachian tube extends from the anterior portion of the tympanum, exactly opposite the mastoid cells, in a direction downwards, forwards, and inwards. It should be borne in mind that this tube does not run from the very floor of the cavity, but from about half the way up, so that if fluids be injected through it with sufficient force, they will pass into the mastoid cells, and also partially remain at the bottom of the tympanum. For this reason I object to the frequent injection of medicated or other fluids. The tube consists of a bony and of a fibro-cartilaginous portion, and in this respect resembles the external auditory canal; but the proportionate length of the two parts is here reversed. In the Eustachian tube, the length of the osseous part is from half to three-quarters of an inch, while the membranous is about an inch. Its faucial orifice is the widest and most dilatable; but further up, where the cartilaginous and bony parts unite, it is so small as scarcely to admit a probe. This point is often called the isthmus of the tube. The tube itself is thus trumpet-shaped, having a gaping orifice, which usually is situated a trifle higher than the floor of the nares; but it occasionally varies in position, and when the naso-pharyngeal membrane is tumefied, or the inferior turbinated bone projects a little over the orifice, difficulty is experienced in guiding instruments into it.

The mucous membrane lining the Eustachian tube varies in structure. At the faucial end it is very thick and puffy, and sometimes lies in such folds as to obstruct the free entrance of air into the tympanic cavity, even when attempted to be forced in by the catheter or by other methods hereafter to be referred to. On account of these folds and of some largish glands, you will often feel, as it were, your way into the opening at the pharynx; but seldom will the surgeon, practised in catheterism of this part, fail to insert the point of the instrument, if he do not employ force or haste in his manœuvres. As the tube extends upwards towards the tympanum, the lining mucous membrane becomes thinner until it reaches the tympanic orifice, where also there are glands, and it is more vascular. Further (and the best) description of the tissues composing the tube and their microscopical appearances may be found in Dr. Von Tröltsch's work "On the Diseases of the Ear."

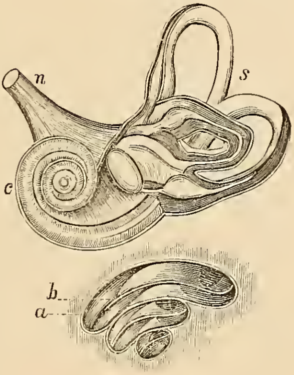
The chief use of the Eustachian tube is to provide ingress and egress of air to and from the tympanum, so as to bring about a regular interchange of air between that contained in the naso-pharyngeal cavities and that within the drum. It is now generally believed by anatomists that the surfaces of the Eustachian tube usually lie in contact, and that the too ready ingress of atmospheric air to the tympanic cavity is prevented by the tensor and levator palati muscles; also that the principal function of these muscles is to open the tube during their contraction in the action of swallowing. It necessarily follows that whenever this act is performed, the Eustachian tube must be opened. Afterwards, its lips again fall together, and no air can enter or recede from the drum. It is obvious that the tympanum must thus be generally a closed cavity, and will contain air of the same density as that on the outside, air only entering and escaping from its interior in such proportion as is needful for maintaining the same tension on both the inner and outer side of the membrana tympani. Without such an arrangement for the renewal and equalisation of air, the requisite vibratility of the tympanic membrane could not be kept up,—the air would become exhausted or absorbed, the membrana tympani and ossicles would fall inwards, and cause pressure upon the vestibular fenestra and labyrinth-fluid. You frequently see this state of things as the consequence of catarrh affecting the mucous lining of the Eustachian tube, and causing an obstruction to the passage of air into the drum; and you will also often have the pleasure of witnessing the restoration of the lost hearing by the use of a simple and efficacious contrivance,—Politzer bag, which will be again referred to.

MASTOID CELLS.

The cavity of the mastoid portion of the temporal bone is filled with a number of spongy bone-cells, all lined with the same mucous membrane, lining the drum cavity, which, of course, renders them liable to partake in the diseases of the cavity of the drum, being in direct anatomical and aerial communication with the same, and it is very neccessary to bear these anatomical relations in mind, when inflammation attacks the cavity of the drum. These cells have also a ready communication with the lateral sinus (cavity) by several small apertures through which veins pass to the sulcus lateralis (lateral groove) and small arteries likewise freely enter the *dura mater* (outer membrane of the brain) which adheres internally to the superior surface of the *mastoid process*. In childhood the *mastoid process* is in a rudimentary state, the only part of it represented being the horizontal portion adjacent to the tympanic cavity; and it is this particular part which so frequently becomes affected in early life, when disease invades the drum. The walls of both are contiguous at their upper part, and as the dura mater and cerebral (brain) cavity lie immediately above, it is obvious that irritation of the brain or cerebral abscess may readily ensue from disease in the *mastoid cells* consequent upon scarlet fever, measles, scrofula, or even common catarrhal inflammation.

INTERNAL EAR, OR LABYRINTH.—*“This is composed of the *vestibule*, *semi-circular canals*, and *cochlea*.

FIG. 4.



LABYRINTH OF THE EAR.
n. Auditory nerve. *s.* Semicircular canals. *c.* Cochlea. *a.* Osseous wall of the spiral tube of the cochlea. *b.* Spiral staircase.

The vestibule is the middle portion. On its outer wall are the fenestra ovalis and fenestra rotunda. In its inner wall is the foramen of the *aqueduct of the vestibule*, going to the back part of the petrous portion of the temporal bone. In front is a large opening communicating with the cochlea; *apertura scalæ vestibuli cochleæ*. Behind, five orifices open from the vestibule into the semi-circular canals.

The three *semi-circular canals* are above and behind the vestibule. They are unequal in length and different in direction; two being vertical and one horizontal.

The *cochlea* is shaped somewhat like a snail-shell. It is anterior to the vestibule. It consists of the *modiolus* or *columella*, which is its central axis, and a spiral canal wound around this, with the *lamini spiralis* (partly osseous and partly cartilaginous), contained within the canal. The spiral canal has two turns and a half. The interior is divided into two equal scalæ or staircase-like passages (*scala tympani* and *scala vestibuli*) by the delicate *lamina spiralis*; upon which the nerve filaments of the auditory nerve are spread out. In the substance of the lamina spiralis is the *scala media*, which contains the piano-key-like *rods of Corti*. The terminations of that nerve are also distributed to the vestibule and semi-circular canals.

* Hartshorn's Conspectus of the Medical Sciences, page 204.

The whole inner surface of the bony labyrinth is lined by a fibro-serous periosteal tissue. In the vestibule and semi-circular canals, it separates the osseous from the membranous labyrinth; its fibrous coat being attached to the bone, and its free serous layer to the membranous interior structure. In the cochlea, it covers both surfaces of the osseous zone of the lamina spiralis and then forms the membranous zone (*zono Valsalvæ,*) or continuation of the same to the cochlear wall. The *liquor Cotunnii* or *perilymph* is the fluid secreted within the periosteal double layer.

The *membranous labyrinth* is the internal duplicate of the vestibule and semi-circular canals. The vestibular portion of it is formed into two sacs, the *utricle* and the *saccule.* The *endolymph*, or *liquor Scarpæ,* is the fluid contained within the labyrinth. The *otoliths* or *otoconia* are two small round collections of crystals of carbonate of lime, surrounded by fibrous tissue, in the vestibule."

THE AUDITORY NERVE, or *portio mollis* of the 7th pair, enters the meatus auditorius internus and divides into a vestibular and cochlear branch, which are expanded upon the membranous labyrinth and the walls of the cochlea.

ANATOMICAL OBSERVATIONS.

"A finely formed auricle [I quote from Dr. St. John Roosa's Treatise,*] is justly esteemed one of the marks of personal beauty. The celebrated physiognomist, Lavater, also attached considerable importance to this part in determining character. A humorous German critic, quoted by Voltolini, in speaking of Lavater's ideas of physiognomy, says: 'It would be very queer of Dame Nature, if she had hung every one's character on the nose, so that any one who was a master in physiognomy could read it. Perhaps fearing this, some people shut their eyes and are ashamed to look one in the face.' A French author, Dr. Amédée Joux, quoted by Von Tröltsch, goes much farther than Lavater in his estimation of the signification of the auricle; and besides the part which it plays in indicating human character, he claims that, more than any other organ of the body, it descends with its particular form from father to child, and that by the shape of the auricle we may be assisted in determining the legitimacy of children, and the conjugal fidelity of a mother. He says, '*Montre-moi ton oreille, je te dirai qui, tu es, d'ou tu viens, et ou tu vas,*' or, as we should say in English, 'Let me see your ear, and I will tell you who you are, where you came from, and where you are going.'

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* Roosa's Treatise on the Ear, 4th Edition, p. 102.

I am inclined to think that this view of the importance of the auricle is Gallic, rather than truly physiological. Recent authorities, such as *Gruber* of Vienna, believe that the grace and beauty of the auricle have little influence upon the functions, whatever may be the physiognomic or other significance of the part. It makes very little difference as regards the hearing power, however much it may affect personal beauty, whether the auricle lies exactly at a proper and graceful angle on the head, or whether it be closely adherent, and thus simply form an ugly appendage; and yet the auricle has functions, although, like the muscles which move it, these functions in man are comparatively unimportant and rudimentary. We all know, however, that there is some importance attached to this part by persons with impaired hearing; for all of us have seen such persons place the hand behind the auricle when listening intently, in order to facilitate the conduction of sound into the auditory canal.

Voltolini* considers the auricle to be a reflector, condenser, and conductor of the waves of sound. As a reflector, the fossa of the concha throws the sound-waves against the tragus, whence they pass into the auditory canal. This author is inclined to the belief that when the auricle is small the concha is deeper, in order to compensate for the loss. The auricle is a condenser of sound, just as is every other firm and elastic body. Its chief function, however, according to Voltolini, is that of a conductor of sound. If it were merely a reflector and condenser, it would have done its work better if formed of bone. It is to be considered as an external membrana tympani. This outer membrane is placed in different degrees of tension by reflex action, just as is the true membrana tympani by the tensor tympani muscle. This may be illustrated by observing the operation of syringing the ear. At the entrance of each stream of water, the auricle moves, and at times this motion is sufficient to cause a backward current of the water from the ear. Again, many persons with impaired hearing can hear the watch, if it touch but the outermost tip of the auricle, while it cannot be heard if held but a line removed from the part.

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*Monatsschrift fur Ohrenheilkende, Jahrgang II, No. 1.

Voltolini sums up his consideration of the auricle, by saying that 'the auricle may be considered as the outer orifice of a hearing or speaking-tube, of which the external auditory canal is the tube proper—and since the sound receiver is so large in proportion to the calibre and length of the tube we may see what nonsense it is to recommend the so-called invisible ear-trumpets, which are simply short aural specula.'"

"Opposite opinions have been entertained," says Toynbee, "respecting the influence of the external ear upon the hearing power. Itard denied that it was of any use, while others have considered that it is of very material service in collecting the sonorous vibrations, and in conducting them to the meatus. Richeraud says that the external ear may be removed without deafness being the consequence. Dr. Hennese cites a case that he met with, in which the external ear was completely removed by a cannon shot, and yet the sense of hearing was as acute as ever. Wepfer relates a case in which the outer ear was destroyed by ulceration, but the hearing power was not diminished."

The author had, at one time, a man in his employ, who, through a railway accident, had the misfortune to have *both* ears closely severed from his head—not leaving a vestige (save the cicatrix) to indicate they ever existed—but whose hearing power, notwithstanding the loss, seemed unimpaired. When questioned as to the effects of his misfortune he jokingly remarked that (like the fox, in Æsop's Fables, that had lost its tail in a trap) he thought them unnecessary appendages and that he never felt better than since being deprived of them.

Itard says: "Everything combines to show that the auricle is absolutely useless in man; that the hearing is not altered when it is removed, I have had occasion to assure myself most positively." He owns, however, that this opinion has been opposed by various anatomists, among whom may be cited Valsalva and Haller, who state positively, that although the loss of the outer ear does not produce deafness, it is always accompanied by a diminution of the hearing power. Leschevin also states that those who have lost the external ear, or have it naturally too flat or ill-shaped, have the hearing less acute. (Cooper's Surgical Dict., 7th Ed., p. 459.)

PART II.

PHYSIOLOGY.

PHYSIOLOGY.

HEARING.—* " The sense of hearing depends upon the vibrations excited in the atmosphere by sonorous bodies, which are themselves first thrown into vibration by various causes, and which then communicate similar undulations to the surrounding air. These sonorous vibrations are of such a character that they cannot be directly appreciated by ordinary sensibility, but the result of numerous and well-directed physical experiments on this subject leaves no doubt whatever of their existence; and when such vibrations are communicated to the auditory apparatus, they produce in it the sensation of *sound.*

In the case of the aquatic animals, which pass their entire existence beneath the surface of the water, the water itself, which is capable of vibrating in the same way, communicates the sonorous impressions to the organ of hearing; but in terrestrial animals, and particularly in man, it is the atmosphere which always serves as the medium of transmission.

The auditory apparatus, in man and in the quadrupeds, consists, first, of a somewhat expanded and trumpet-shaped mouth, or *external ear,* destined to receive and collect the sonorous impulses coming from various quarters. This external ear is constructed of a cartilaginous framework, covered with integument, loosely attached to the bones of the head, and more or less movable by means of various muscles, which by their contraction turn its expanded orifice in different directions. In man, the movements of the external ear are almost always inappreciable, though the muscles may be easily demonstrated; but in many of the lower animals these movements are exceedingly varied and extensive, and play a very important part in the working of the auditory apparatus.

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*Dalton's Treatise on Human Physiology, page 505.

At the bottom of the external ear, its orifice is prolonged into a tube or canal, the *external auditory meatus,* partly cartilaginous and partly bony, which penetrates the lateral part of the temporal bone in a nearly horizontal and transverse direction. In the human subject, this canal is a little over one inch in length, and is lined by a continuation of the external integument. The integument toward its outer portion is beset with small hairs, and provided with ceruminous glands which supply a secretion of a waxy or resinous consistency. By these means the passage is protected from the accidental ingress of various foreign bodies.

Secondly, at the bottom of the external meatus the auditory passage is closed by a thin fibrous membrane, stretched across its cavity, called the *membrana tympani.* Upon this membrane are received the sonorous vibrations which have been collected by the external ear and conducted inward by the external auditory meatus. Behind the membrana tympani is the cavity of the *middle ear,* or the cavity of the tympanum. This cavity communicates posteriorly with the mastoid cells, and anteriorly with the pharynx, by a narrow passage, lined with ciliated epithelium, and running downward, forward and inward, called the *Eustachian tube.* A chain of small bones, the malleus, incus, and stapes, is stretched across the cavity of the tympanum, and forms a communication between the membrana tympani on the outside, and the membrane closing the foramen ovale in the petrous portion of the temporal bone. All the vibrations, accordingly, which are received by the membrana tympani, are transmitted by the chain of bones to the membrane of the foramen ovale. The tension of the membranes is regulated by two small muscles, the *tensor tympani* and *stapedius* muscles, which arise from the bony parts in the neighborhood, and are inserted respectively into the neck of the malleus and the head of the stapes, and which draw these bones forward and backward upon their articulations.

Thirdly, behind the membrane of the foramen ovale lies the *labyrinth,* or *internal ear.* This consists of a complicated cavity, excavated in the petrous portion of the temporal bone, and comprising an ovoid central portion, the *vestibule,* a double spiral canal, the *cochlea,* and three *semicircular canals,* all communicating by means of the common vestibule. All parts of this cavity contain a watery fluid termed the perilymph. The vestibule and semicircular canals also contain closed membranous sacs, suspended in the fluid of the perilymph, which reproduce exactly the form of the bony cavities themselves, and communicate with each other in a similar way. These sacs are filled with another watery fluid, the endolymph; and the terminal filaments of the auditory nerve are distributed upon the membranous sac of the vestibule and upon the ampullæ, or membranous dilatations, at the commencement of the three semicircular canals. The remaining portion of the auditory nerve is distributed upon the septum between the two spiral canals of the cochlea.

Thus, the essential or fundamental portion of the auditory apparatus is evidently the internal ear, a cavity, partly membranous and partly bony, in which is distributed a nerve of special sense, the auditory nerve, (portio mollis of the seventh pair,) capable of appreciating sonorous impressions. The accessory parts, on the other hand, are the chain of bones and the membrane of the tympanum, which communicate the sonorous vibrations directly to the internal ear; and the meatus and external ear, which collect them from the atmosphere. The reception of sonorous impulses is therefore accomplished in a very indirect way. For the sonorous body first communicates its vibrations to the atmosphere. By the atmosphere these vibrations are communicated to the membrana tympani. From the membrana tympani, they are transmitted, through the chain of bones, to the membrane of the foramen ovale; thence to the perilymph, or fluid of the labyrinthic cavity, and from the perilymph to the membranous parts of the labyrinth and the nerves which are distributed upon them.

The arrangement of the different parts composing the *tympanum* is of the greatest importance for the perfect enjoyment of the sense of hearing. For the air on the two sides of the membrane of the tympanum should be in the same condition of elasticity in order to allow of the proper vibration of the membrane; and this equilibrium would be liable to disturbance if the air within the tympanum were completely confined, while that outside is subjected to variations of barometric pressure. By means of the Eustachian tube, however, a communication is established between the cavity of the tympanum and the exterior, and the free vibration of the membrane is thus secured.

The *exact tension of the membrana tympani itself* is also provided for, as we have already observed, by the action of the two muscles inserted into the malleus and the stapes. By the contraction of the internal muscle of the malleus, or *tensor tympani*, the membrane of the tympanum is drawn inward and rendered more tense than usual. The action of the *stapedius* muscle is by some thought to relax the membrana tympani, by others to assist in the tension both of this membrane and that of the foramen ovale, to which the stapes is attached. But there is no doubt that both these muscles, by their combined or alternate action, can regulate the tension of the tympanic membrane, to an extraordinary degree of nicety, and thus increase the ease and delicacy with which various sounds are distinguished. For if the membrane be so put upon the stretch that its fundamental note shall be the same with that of the sound which is to be heard, it will vibrate more readily in consonance with the undulations of the atmosphere, and the sound will be more distinctly heard. On the contrary, if the membrane be too highly stretched, very grave sounds may not be heard at all, until its tension is diminished to the requisite degree.

Contrary to what is sometimes asserted, the communication of sonorous impulses to the internal ear is accomplished *altogether by means of the tympanum and chain of bones.* It has been thought that sounds were transmitted, in many instances, directly to the internal ear by the medium of the cranial bones. This was inferred from such facts as the following. If a tuning-fork, in vibration, be taken between the teeth, its sound will appear very much louder than if it were simply held near the external ear; and if, while it is so held, one of the ears be closed, the sound will appear very much louder on that side than on the other. The sound will also be heard if the tuning-fork be applied to the upper part of the cranium or the mastoid process, with a similar increase of resonance on closing the ears. Finally our own voices are heard, though the ears be both closed, and the sound is much louder with the ears closed than open.

These are the facts which have led to the belief that, in such instances, the sound was communicated directly through the bones of the head, vibrating in consonance with the sounding body. But a little examination will show that such is not the case. When we hold the end of a vibrating tuning-fork between the teeth, we no longer hear the sound in the vibrating extremity of the instrument or its neighborhood, but *in the mouth and the nasal fossæ.* It is the vibration of air in these passages which produces the sound; and this vibration is communicated to the cavity of the tympanum through the Eustachian tube. The apparent increase of sound, also, on closing the ears, which could not be explained on the supposition that it was conducted directly through the bones of the cranium, is due to the same cause. For it can easily be seen, on trying the experiment, either with a tuning-fork held between the teeth or simply with our own voices, that this apparent increase of sound takes place only when the ears are closed by *gentle* pressure. If the pressure be excessive, so that the integument is forced inward into the meatus and the air in the meatus subjected to undue compression, the sound no longer appears louder in the corresponding ear, and may even be lost altogether.

The apparent increase of sound, therefore, in such cases, when the ear is gently closed, is due to the fact that the meatus is thus converted into a reverberatory cavity, by which the vibrations of the tympanum are increased in intensity. But if the air in the meatus be too much compressed by forcible closure, the vibrations of the tympanum are then interfered with and the sound is diminished or destroyed.

In all cases, then, it is the sonorous vibrations of the air which produce the sound, and these vibrations are received invariably by the membrane of the tympanum, and thence transmitted to the internal ear by the chain of bones. The cranial bones are incapable of communicating these vibrations to the labyrinth and its contents, except very faintly and imperfectly. For common experience shows that even the loudest and sharpest sounds, coming from without, are almost entirely lost on closing the external ears; and our own respiratory and cardiac sounds, which are so easily heard as soon as the chest is connected with the ear by a flexible stethoscope, are entirely inaudible to us in the usual condition.

The exact function of the different parts of the internal ear is not well understood. It has been thought to be the office of the *semicircular canals* to determine the *direction* from which the sonorous impulses are propagated. This opinion was based upon the curious fact that these canals, always three in number, are placed in such positions as to correspond with the three different directions of vertical height, lateral extension, and longitudinal extension; for one of them is nearly vertical and transverse, another vertical and longitudinal, and the third horizontal in position. The sonorous impulses, therefore, coming in either of these directions, would be received by only one of the semicircular canals (by direct conduction through the bones of the head) perpendicularly to its own plane; and an intermediate direction, it was thought, might be appreciated by the combined effect of the impulse upon two adjacent canals.

Enough has already been said, however, in regard to the communication of sound directly through the bones of the head to the internal ear, to show that this cannot be the way in which the direction of sound is ascertained. Indeed, when we hear any loud and well-marked sound coming from a particular region, such as the music of a military band or the whistle of a locomotive, we have only to close the external ears to lose our perception both of the sound and its direction. The direction of sonorous impressions is appreciated in a different way. In the first place, we feel that the sound comes from one side or the other, by its making a more distinct impression on one ear than the opposite; and by inclining the head slightly in various directions, we easily ascertain whether the sound becomes more or less acute, and so judge of its actual source. Many of the lower animals, whose ears are very large and movable, use this method to great extent. A horse, for example, when upon the road, often keeps his ears in constant motion, *feeling*, as it were, in the distance, for the origin of the various sounds which excite his attention.

Beside the above, we are further assisted in our judgment of the direction of sounds by our previous knowledge of the localities, the direction of the wind, and the manner in which the sound is reflected by surrounding objects. When these sources of information fail us, we are often at a loss. It is notoriously difficult, for example, to judge of the place of the chirping of a cricket in a perfectly closed room, or of the direction of a bell heard on the water in a thick fog.

The sense of hearing has a much closer analogy with ordinary sensibility than that of sight. Thus, in the first place, hearing is accomplised by the direct intervention and contact of a material body—the atmosphere; for sonorous impulses cannot be produced in a vacuum, and we hear no sound from a bell rung under an exhausted receiver. Secondly, the nature of the impressions produced by sound is such that we can often describe them by the same terms which are applied to ordinary sensations. Thus, we speak of sounds as sharp and dull, piercing, smooth, or rough; and we feel the impulse of a sudden and violent explosive sound, like that of a *blow* upon the tympanum.

By this sense, therefore, we distinguish the quality, intensity, pitch, duration, and direction of sonorous impulses. The delicacy with which these distinctions are appreciated varies considerably in different individuals; and in different kinds of animals there is reason to believe that the diversity is much greater, some of them being almost insensible to sounds which are readily perceived by others. In man, the number and variety of tones which can usually be discriminated is very great; and this sense, accordingly, in the complication and finish of its apparatus, and the perfection and delicacy of its action, must be regarded as second only to that of vision."

PART III.

HYGIENE.

GENERAL HYGIENE OF THE EAR

I would certainly come short of the object of this book were I to omit to appropriate some space to the important consideration of the *prevention* of disease of this organ of special sense, and the *preservation* of the faculty of hearing. If the old adage, "An ounce of prevention is better than a pound of cure," has more bearing in one case than another, it may justly be claimed in the one under consideration. Devoting, as I do, all my time to the treatment of the ailments incident to this organ, my experience fully satisfies me that a careful observance of the laws of *Hygiene* (as pertaining to this organ) would have *prevented* a majority of the ailments that come under my observation for treatment, and thereby saved a vast number from suffering and loss of hearing. In presenting this subject to the reader, I desire to do so in the best light possible, and to that end I take the privilege to quote the following from "Hearing, and How to Keep It," by that accomplished writer, Dr. Charles H. Burnett, Consulting Aurist to the Pennsylvania Institute for the Deaf and Dumb:

THE CARE OF THE EAR IN HEALTH.

"As a rule, there is either too much toilet of the ears, or there is improper protection of them. On the other hand, there is most flagrant neglect of them, even in health; the organs are unduly and carelessly exposed to bad weather and cold water, and disease is thus brought on in what might have continued to be a perfectly good ear.

THE AURICLE.—To begin with the auricle or outside ear, it may be said that it should always get moderate and gentle washing with a wash-rag in preference to a sponge, and then a gentle and thorough drying.

Whenever it is desirable to protect the ears from cold air or a draught, it should be done by placing over them something that will sit lightly on them, and hence not bind them close to the head. A light and loosely-fitting cap is excellent for the protection of the ears as well as the bald heads of infants. But a tight cap will do their ears great harm by pressing the auricles against the head, causing not only increased perspiration, but, by thus binding down the ears to the perspiring surface, macerate the skin of the ears and set up diseases like 'milk crust.'

Respecting the soap to be used about the ears not only of adults but of infants, it may be said that the best are the simplest. A good soap is not easily obtained. Perhaps a *little* Castile-soap is the safest for children. There is a very good soap called the 'Savon de Guimauve,' a French soap, which is bland, cleansing, free from odor, and hence less liable to putrefaction. Any soap that sours easily should not be used about the ears, nor, in fact, used at all in personal toilet. Children's ears, are as a rule, not only too much washed, but very rudely and painfully washed, especially in the canal of the ear, as we shall speak of further on.

If any one suffers from cold in or about the ears, a light ear-muff or a piece of cotton wool placed lightly in the ear, or ear-pieces from the cap, or a woollen scarf around the ears, will be sufficient protection. In the case of women, a veil or hood will amply protect the ears from cold.

The ears may be protected from the sun by a broad brim to the hat or by a light cape falling from the cap, as in the so-called 'Havelock;' and this will also protect from the sting of insects. The latter covering, however, is apt to be very warm in just the countries where it is most required for protection. A broad hat and a light net or veil will, in such lands, best meet the needs of the soldier or traveler.

Piercing for Ear-rings demands a word of caution. It is usually done by jewelers, and consequently some important points may be unknown to them.

In the first place, the instrument used for piercing the lobule should be thoroughly cleansed after each operation, otherwise a small quantity of animal matter may remain on it, undergo putrefaction, and thus poison the next person operated on. Diseases, too, could thus be communicated from one individual to another. Another point to remember is, that nothing but the soft lobule should be pierced. Where this is small or hard, the greatest care is necessary to insure against perforating the cartilage, which, in all probability, extends into the lobule as stated already.

Ear-rings are sometimes torn from the lobule, thus causing a slit, which heals leaving an ugly deformity in the shape of a kind of double lobule. In one instance, the writer saw a lobule that had been torn twice, thus leaving two permanent slits in it and giving the ear a fringed appearance. After the wound is made, properly fitting together the raw edges would prevent the deformity; but the latter once formed by healing wrong, can be corrected only by the surgeon's knife.

A word of caution must therefore be given here respecting that most reprehensible custom of pulling children's ears in punishment. Though this practice is not as dangerous to hearing as one yet to be named when considering the drum-head, viz., 'boxing the ear,' it is nevertheless open to great condemnation, as being not only cruel, but very likely to inflame the dense fibrous tissues holding the auricle in place. Such an inflammation, if not speedily checked, would lead to hardness of hearing, and, perhaps, permanent deafness. Should the bone entering into the frame-work of the ear, underlying these inflamed structures, also become involved in the aforesaid inflammation, results even fatal to life may ensue. The auricle is often subjected to considerable roughness in washing. This should be avoided, as it is not necessary to cleanliness, and often excites general inflammation of the part or local inflammation in the form of boils. After washing the auricle, great care should be taken to dry it thoroughly, and also the prominent bone behind it and the hair that, in some persons, lies very near or even touches it. If any dampness is allowed to remain in or about the auricle, evaporation, as every one ought to know, reduces the temperature and renders the ear liable to 'catch cold,' *i. e.* to become the seat of catarrh. The popular idea, therefore, that dashing cold water against the auricle, and even into the ear-canal, is healthful or strengthening to the organ, is wrong.

AUDITORY CANAL.—Of still greater importance is the hygiene of the auditory canal,—the canal leading down to the drum. Here we constantly meet with the bad results of too much washing, picking, scratching, swabbing, etc.

Referring to the anatomy and physiology of this part of the ear, we find that it is a canal lined with delicate skin, and, at its mouth, naturally smeared with ear-wax. The latter, therefore, is necessary to the health of the ear, or it would not be there by nature, and it must not therefore be looked upon as dirt.

This canal must be unobstructed, yet well supplied with wax: the first, in order to transmit waves of sound to the drum-head; the second, to keep out insects and worms or any small living creature, and also to keep off the fungus Aspergillus, for the latter will not grow on healthy ear-wax.

This apparent paradox in nature, the necessity for an open canal, and the presence of a gluey substance ever forming at its outer end, is reconciled by the fact that the skin of the ear grows outward and *carries superfluous ear-wax and dust with it.*

It needs no great powers of reasoning to see how easily most things that people do for their ears or put into them, in health, tend to interfere with the operations of nature. So far as the entrance of cold air into the canal is concerned, it may be said that the peculiar spiral shape of this passage prevents the direct blowing of air upon the drum-head.

If, therefore, the ear-wax is to be looked upon as the natural protector of the ear and not as dirt, it should *not* be constantly and sedulously scraped away, as, unfortunately, it is in too many cases. *All superfluous ear-wax will fall from the ear in time if the organ is let alone.* Hardening and packing in of wax in the ear is an artificial product, usually caused by the gradual packing in resulting from the patient's unsuccessful or partial endeavor to remove this important substance from the ear. The skin of the auditory canal grows outward, and naturally carries with it scales of dead scurf-skin and old wax. It is very evident, therefore, that the use of any form of ear-picks, ear-spoons, and bougies, such as towel-corners rolled into cones, so called 'aurilaves,' * of which too much can hardly be said in condemnation, is at direct variance with the mode of nature in emptying the ear of anything superfluous. All such endeavors at cleaning the ear will push in much more than is brought out.

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* An 'aurilave' is a most condemnable instrument, made by fastening a piece of sponge to a bone handle.

The cleanest people are generally those who pack the most wax back into their ears. A morbid idea of cleanliness leads them not only to swab their ears daily, but also to pour or drop into it a variety of fluids, as sweet-oil, glycerine, etc.

Now, as has been said, all this treatment of the ear is subversive of the law of nature regarding the ear's welfare and comfort. More than this, it usually leads in time to positive inflammation.

The scraping away of wax from the mouth of the auditory canal causes the ear to itch. This entails scratching; and the latter is likely to abrade the skin or directly to inflame it.

Abrasion may not only cause the ear to feel sore, but furnishes a moisture consisting of animal juices, which will quickly become putrescent, and thus favor the growth of a mould or fungus called the Aspergillus. The growth of this vegetable parasite in the ear leads to a stubborn and painful inflammation of the skin of the canal and of the drum-head. The latter part is especially sought out by the fungus, and its growth thereon not only inflames the drum and causes pain and hardness of hearing, but it has been known to penetrate the drum.

The use of sweet-oil, glycerine, etc., has its evil results, too, even if the inordinate wiping or picking the ear is not indulged in. *Sweet-oil,* so constantly and popularly employed in aural diseases, has no virtues whatever in the treatment of ear-disease, but, on the contrary, possesses positively bad qualities as an application to the ear. Because, besides having no good solvent effect on wax, it clogs the ear, increases pain, and does harm by its tendency to become rancid. When once put into the ear, sweet-oil, or any other fat, is usually soon forgotten, and allowed to remain there until it is rancid. This supplies the fungus alluded to with a most encouraging soil in which to grow.

Glycerine, too, has its ardent advocates, who consider it as bland as it looks. But glycerine has affinity for water, and therefore acts like a caustic. Hence, glycerine, unless greatly diluted with water, when put into the ear, burns and stings until the ear is in the first stages of inflammation. There is no doubt that it possesses solvent power over ear-wax, but, when employed for this purpose, it should be well diluted with water, in the proportion of at least one to eight or ten. In such a preparation only, can it be, or has it ever been, of service, and then only as a solvent to a plug of ear-wax which, in all probability, the patient had formed in his ear by his own meddling.

As the auditory canal is the only external conduit to the ear, and also one easily got at by both physician and patient, it has ever been a channel through which much deleterious matter has passed to the deeper parts of the ear, both before and since the time of Hamlet's father. It may be set down here as an axiom, that nothing should ever be put into the ear to cure toothache. This is a popular mode of treatment which constantly leads to injury of the organ of hearing, yet, so far as I know, never has cured a toothache. Not long since, there was removed by the writer, from the ear of a Swedish woman, three pepper-corns, which she had steeped in cologne water and placed in her ear sixteen years previous, for the cure of toothache. The latter passed off, as most toothaches will, in time, and the pepper-corns were forgotten. Years after this, a cold brought on a slight swelling in the skin of the auditory canal, and this, closing around the pepper-corns, which were almost equal in diameter to that of the auditory passage, greatly intensified the inflammation and excited the most violent pain, not only from the pressure of the skin upon them, but from their irritant qualities, which were once more brought out by the softening effect of the fluids which poured from the skin of the ear in its diseased state, and also by various matters dropped into the ear by the woman in her attempts to relieve her suffering. All such mismanagement of the hygiene of the ear inevitably leads to pain and injury.

Still more common is the practice of putting almost numberless substances, chiefly fluid, into the ear for the cure of deafness. A laughable list might be given, consisting, in part, of such things as rabbit's fat, eagle's gall, neat's-foot oil, human urine, milk of women and of the cow, and vast numbers of matters equally useless so far as remedying deafness is concerned. There is now and then a more serious aspect to such purely nonsensical treatment of the ear. The above-named articles, as a rule, do no harm, but when one individual succeeds in inducing another to pour boiling oil into the ear, as occurred in a case which came under the writer's notice, then the utter folly of domestic treatment becomes apparent.

The great danger attending scratching the auditory canal has been alluded to when speaking of injuries of the drum-head. It will therefore be hardly necessary to allude specially to the folly of such practices.

Itching of the ear is at times intense, and the natural impulse is to scratch and relieve it; but this must be done with the finger, or not at all. If this will not relieve it, hair-pins and pins must not be used to scratch the canal of the ear, for reasons already given.

When itching of the ears keeps up, syringing with warm water may give relief; but usually there is some diseased condition at the bottom of the annoyance, and the surgeon alone can give permanent relief.

Already, many directions as to what should not be done have been given. A few words are therefore necessary as to what may be done in the form of hygiene of the auditory canal. The auricles may be protected in cold weather *and in the open air* by ear-muffs, a veil, or a scarf, and these also protect the auditory canal. This is preferable to protecting the latter by putting cotton in it. The latter is more convenient, and of course less visible. If the ear is free from discharge, and yet suffers from pain whenever exposed to the cold air, a piece of cotton or wool may be worn lightly in the ear when in the open air—but only there and *never* in the house. The entire ear can be made tender by wearing cotton in it in the house, and its wax can be packed back by practising such a habit; it is thus kept too warm, the cotton acts like a poultice, and the ear is then not uncommonly drawn to a running. It is also a dirty habit, for the cotton is not likely to be changed very often if worn constantly, and not uncommonly is it pushed into the ear and forgotten. Hardness of hearing is thus gradually brought on.

Cotton may, however, be worn in swimming or diving, especially in the latter, in order to prevent the entrance of water into the ear. It is not easy, however, to keep it in the ear, unless it is held in by a cap of some kind.

Here, then, a caution must be inserted in order to further protect the ear and its functions. It does seem that a prolonged swim, or numerous repetitions of swimming, in cold water, are more likely to produce inflammation of the ear, than a short and solitary indulgence in this summer sport. In addition to brevity of the bath, it would also be only safe to stop the ear with cotton during the swim. It is much better for boys and girls in a city to swim in a natatorium, where the water is never allowed to become cold. As for swimming every day in cold brook-water, as so many boys, and sometimes girls, in the country do, it is not only useless, but it is positively liable to injure both health and hearing. Bathing in the sea and surf has many points of danger to the ear, which must be noted. Prominent among these is the direct force of the waves and breakers, to which the ear may be exposed. A physician, a friend of the writer, while bathing in the sea, received a breaker against the side of his face and in his ear, resulting in a rupture of the drum and permanently defective hearing. But these cases are common in the experience of every surgeon who is employed in observing ear-diseases.

Other dangerous attendants of sea-bathing are the coldness and stimulating properties of the sea-water. In fact, so far as the ear is concerned, these two properties of sea-water render it an irritant to the ear, and the number of cases of ear-disease, from slight earache to a long-continued and painful inflammation of the ear, occurring at the seaside in summer-time, is something calling for attention not only on the part of the bathers, but of their medical advisers.

This dangerous quality of sea-bathing is only one more argument against its now indiscriminate use, and the positive abuses to which it has come. The old idea that nobody can catch cold, either in or out of the water, at the sea-shore, has been exploded long ago, in the minds of physicians of any experience along our coast, and should be extirpated from the minds of the public as soon as possible. A short bath once or twice a week may be a good tonic in some cases, if it is enjoyed; but as for staying in the surf until ears and lips, as well as fingers and toes are livid, as many, chiefly women, do, it is self-evident that catarrhs of all kinds must prevail among sea-side bathers, as in fact such diseases do. Fine swimmers remain in the surf, as is well known, for hours. Not long since, the writer was consulted by one of these phenomenal swimmers, who had remained one hour and forty minutes, swimming up and down the surf at Cape May. The surf was high, and the water was cold—it was in June; and the result of this indulgence in the bath was a severe inflammation of the drum, for the water had entered the ear most exposed to the direction of the surf, constantly and with some discomfort to the patient, while in the water. In all cases of sea-side bathing, if it is likely that the head of the bather is going under the surface of the water, the ear should be protected by cotton, held in position by an oiled silk cap.

After coming from the bath, the old idea that they cannot take cold is followed out by the bathers, and they sit about in draughts, the ladies taking this opportunity to dry their hair. This practice leads constantly to colds, and not uncommonly to earache. The sea-side is the place where perhaps one easily takes cold in all parts of the body.

In fact, it is to be hoped that the day is not far hence when it shall be a rare exception to see men, women, and children bathing in the surf. It is desirable that the salt water bath should be taken in a private bath-house, either in or near the hotel, where the temperature can be made to assure not only comfort, but in some cases the demands of health. The establishment of the latter custom would not only be vastly more judicious, so far as the health of the body and the welfare of the ear are concerned, but it would do away with much that is grotesque in dress and immodest in behavior.

Too much in praise of the sea-air as a tonic to health, and hence to those affected with ear-diseases of all kinds, cannot be said. We do not wish to be misunderstood on this point, for we have seen good results in ear-diseases from a residence at the sea-side, but without the daily cold-water bath,—for reasons already given.*

EFFECTS OF ALCOHOLIC DRINKS AND TOBACCO ON THE EAR.—It has often been urged that both of these very useful things are injurious to the hearing as well as to other important senses of the body. Their *abuse* certainly is injurious to the ear as well as to the entire body and its organs of special sense.

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* The injuries done to the ear by improper bathing, and cold bathing in summer, are graphically shown in a paper by Dr. Samuel Sexton, of New York city, in N. Y. Medical Record of May 4, 1878.

So far as the ear is concerned, it may be said that the undue use of alcohol will injure the hearing in two ways, viz., by inflaming the throat, and thence the Eustachian tube and middle ear, and also by a congestion of the internal ear. It is therefore not advisable to use it when the ear is acutely inflamed.

Tobacco in all forms has received great condemnation from aurists. Smoking is the least objectionable; but chewing and snuffing are, without doubt, more likely to produce, respectively, catarrh of the throat and nose, and hence ear-diseases and deafness. But moderate smoking of cigars—not cigarettes—cannot be shown to be injurious to hearing. Women who have never smoked become deaf at the same age and to the same degree as their brothers or fathers, who have smoked, and continue to do so, without any demonstrable effect on their deafness. In all cases, however, it may be dangerous to hearing to blow the smoke through the nose, as in that act the smoke is brought directly to the mouth of the Eustachian tube, and may set up irritation there. As cigarette smoke is usually thus blown out, this may be the reason of its supposed greater harmfulness to the ears.

Perhaps, too, the fumes of the paper-covering of the cigarette may have an especially injurious effect on the ears. With this proviso, that no smoke should be blown through the nose, a person deaf or only hard of hearing may be allowed to smoke say one cigar after each meal. A very important consideration in this question of smoking and its effects on the ears, is the time and place for the indulgence. An atmosphere loaded with tobacco-smoke is more injurious than a smoke in a properly-ventilated room; and spending an entire evening in a crowded restaurant or club-room filled with smoke, is very bad for all kinds of catarrh, especially for catarrh of the throat, nose, and ears.

EFFECTS OF GREAT NOISES ON THE EAR.—We have already alluded to the effects of sudden and powerful concussions on the ear. These occurrences as alluded to are mostly purely accidental, and hence unavoidable. But there are some noises which may do harm to the ear, and yet can be avoided; as, for example, shouting suddenly in a person's ear. This is not only a cowardly act, but one which, coming suddenly on the individual and on the ear entirely unprepared for the shock, may result in permanent deafness.

The shock to the nervous system is also very great and often disastrous.

Closely akin to this in effect is the constant clatter of machinery. This can best be guarded against by wearing something over or in the ear when exposed to such sounds. Boiler-makers are especially exposed to the bad effects of noises on the ear.

The nerve-power seems to be at last exhausted by the excessive and constant noise to which it is subjected. In the end, the result is similar to that produced by a great blow or fall on the head."

THE CARE OF THE EAR IN DISEASE.

THE AURICLE.—"In a large number of diseases of the auricle, some directions as to washing this part of the ear may be given with advantage to the sufferer.

In the acute and painful inflammations of the skin of the auricle, it will be found that washing it with soap and water, or with water alone, will do more harm than good. When the skin is red, swollen, hot, and stinging, and perhaps broken and weeping, it will be found that to dust over it some finely powdered starch, or to smear it over with a bland mucilage of slippery elm or quince seed, or a bland oil, like sweet-oil, will give the most relief, until a physician can be called to prescribe other remedies.

So long as the inflammation of the auricle is limited to that part, no fears for the welfare of the hearing need be entertained; but watchfulness, lest the disease should spread to the auditory canal and drum, should always be maintained.

AUDITORY CANAL.—When the ear runs, as it often does in children, no cotton, nor any such substance, should be worn in the auricle or the auditory canal, for it not only keeps in the discharging matter, but helps to further inflame the ear. It may be well said that it is 'too heating.'

The discharge from an ear should be removed as fast as possible, usually by the syringe, otherwise the odor from the ear becomes intolerable. Even when using a syringe regularly, sometimes the ear cannot be kept from smelling badly. To plug it up with cotton, as many very well-disposed parents do, is to dam up the pus, or mucus, coming from the deeper parts of the ear, and to make the ear smell more than it otherwise would. The cotton soon gets soaked with matter which rapidly putrefies; this soaked pellet of cotton softens and irritates the parts of the ear it touches, and the welfare of the ear and the comfort of patient and his neighbors are endangered. It is thus that most of the cases of *eczema*, or tetter, are excited in the ear. When the latter disease invades the canal, as it does not uncommonly, the patient usually makes the disease rapidly worse by rubbing up the corner of a towel or wash-rag, soaping it well, and running it down the canal as far as possible. This not only increases the disease, but packs in the cast-off matter, and lays the foundation of a soil most fruitful for the growth of the fungus Aspergillus.

The syringe is the only proper means of cleaning the ear, if the ear must be cleaned. It would indeed be better for a number of children, as well as adults, if nothing but the syringe and warm water had been used in the domestic treatment of their ear-diseases. But, on the contrary, as soon as any one, child or adult, is affected with aural disease of any kind, every one in the circle of his acquaintance has some nonsensical remedy to suggest. These are usually in the form of 'drops' of some kind of oil, than which nothing can be worse for the ear. It had better be let entirely alone, than that oil of any kind should be put into it. Oil will not dissolve ear-wax, therefore it will do no good when the wax gets plugged in the ear. The folly as well as the harm of using it in other diseases of the external, has already been alluded to, and the utter impossibility of reaching the middle ear, with oil dropped into the external ear, is shown from the anatomy of this part of the ear.

The properly educated physician is the only one who can tell what is the nature of the ear-disease, and what should be done for it. The ear had indeed better be let alone, than that the wrong thing should be done for it.

It has always seemed so strange to the writer, that any old woman's remedy is preferred by those affected with aural disease. There was never such a remedy yet advised that was not folly and injury combined, and yet it is readily accepted and followed, while any advice the surgeon may give, is often looked on with suspicion, after the patient's mind has been deluded by '*old wives' fables.*'

A person afflicted with ear-disease should be very careful not to get the feet wet, nor to expose the body incautiously to great changes in temperature. In public places of amusement or instruction, a seat should be chosen out of draughts. Upon entering such places, the outer wrappings, furs, overcoats, and the like, should be removed. If this is not possible, then an extra shawl, or covering of some kind, should be carried on the arm to the hall, to be put on *over the wrappings* on leaving the audience-room. Always, upon leaving warm audience-halls of any kind in the winter season, great care should be taken by every one to protect the heated and fatigued body from cold.

There is nothing more injurious to hearing—especially poor hearing—than chilling of the body, the feet or the head.

A sedentary or secluded life is also injurious to hearing. Any one partially deaf should avoid, if possible, close confinement of any kind. Hard study and the neglect of pleasant companionship will tend to make the hearing worse, as will all depressing influences, like nursing the sick, or the indulgence in immoderate grief. Natural feeling in sorrow cannot be suppressed, but weeping is very depressing to the hearing, as well as other functions of the body. All these facts should be borne in mind by any one affected in hearing, and the effort should be made to avoid anything which would tend to make the ear disease worse.

The young, when affected in hearing, should not be permitted to retire from society, but should be most carefully induced to act like others of their age and social position. It might be said here, that when dancing is indulged in, great care should be taken that chilling does not occur, from exposure of the patient to cold night-air while the body is still very much heated. It should ever be remembered that at best the body is weaker as the night advances, and is a ready prey to treacherous diseases, like catarrhs. The latter are especially injurious to the ears.

There yet remains a word to be said about the clothing, bathing, and sleeping attire and apartments of those hard of hearing. The under-clothing is of the highest consideration, and should be worn of a heavy kind by both sexes. The partially deaf should defy the cold by their heavy clothing. So far as concerns the feet, they should always be protected by heavy shoes, and in winter-time by rubbers. The latter are the only sure protection against moisture, and they keep the feet warmer than leather shoes. The latter may be comparatively light, if arctics or rubbers of some kind are worn. If they should cause the feet to perspire, the stockings should be changed in the middle of the day for dry ones. This should be done, in most cases, by every one, whether affected with ear-disease or not.

Great injury to the ears arises from the cold plunge- or the cold sponge-bath, especially if the ears get water in them; furthermore, the chilling of the body, which is sure to take place if a glow is not felt immediately after the bath, is likely to act unfavorably on the ears, especially in catarrhal ear-disease and deafness. It is in such cases that the mistaken idea of hardening the body and the ears is shown. *Cold* water must never enter the ears nor the nostrils, if it can be kept out.

The person affected with deafness, especially that arising from catarrhal disease in the throat, nose, and middle ear, should not sleep without an undershirt, nor in a draught. If the room is large and the patient sleeps alone, the windows should be closed in cold weather, and ventilation sought through an adjoining room. If the room is rendered close by more than one person's presence during sleeping hours, great care should be taken that the matter of ventilation is not overdone, as it is apt to be in our country, by allowing too much air to enter the apartments. I know that we hear a good deal about 'hardening' people or making them 'tender,' but the former is not accomplished by sleeping in the cold nor will being comfortable make them weak and delicate. All these attentions are demanded in the case of children.

In them, especially the younger ones, from one year to eight or ten, deafness is often attended with disease and stoppage of the nose. The child then breathes through its mouth. This is very injurious to the throat and ears, the chest, and the general health and development of the body.

The child's enunciation is ruined by it, causing him to 'talk through his nose,' as it is termed; but in reality that is just what it does not do, for his nose is stopped up. The nasal sounds are lost from his speech, and hence the peculiar and disagreeable twang to his voice.

His nose collapses and looks pinched, the expression of the upper lip is spoiled, and his face, thus being altered, becomes foolish and stupid-looking. The nose is a kind of sifter of the air breathed through it, and it also warms the air we draw through it before it enters the lungs. This advantage is lost if the nose is stopped up.

At night the child chokes from dryness of the throat, and snores because forced to sleep with his mouth open. His rest is disturbed, his health fails, and his hearing grows worse.

Even after the obstructions are removed, either by nature or by art, the child may have learned a bad *habit* of breathing through its mouth. This must be looked after, and the child, if old enough, must be reminded to breathe through its nose. Much can be overcome by thus correcting the child from time to time. It is good for the ears, as it ventilates them, to oblige the child regularly, three or four times a day, to close his lips and breathe forcibly through his nostrils for several minutes. This cleans the nostrils, and brings to them the natural tonic of breathing air *through them* into the throat and lungs.

It is absolutely necessary to the health of the nostrils to breathe air through them, for that is their function; but it is just as unnatural and injurious to snuff up water into them. A moment's reflection will show that they are air-passages and not water-conductors.

Hence, in applying liquid medication to or through the nostrils, it should always be warmed, and never snuffed hard into the nostrils, but it should be rather poured into first one and then the other nostril, until it is felt gently trickling into the throat. But nothing which causes pain, stinging, or tingling in the nostrils should be used in them as medicine.

If the patient applies nothing to his nostrils or ears without the advice of an intelligent physician, no danger will be likely to occur from treatment applied to these parts.

Hearing-Trumpets.—A child is rarely obliged to use a speaking or hearing-trumpet, although many a child might be kept from becoming a deaf-mute, if he were taught to speak by using some form of trumpet to aid him in hearing.

There are many adults, however, who, from the incurable nature of their deafness, are obliged, or should be obliged, to use a hearing-trumpet. Such an aid to hearing is not only an advantage to them, but a great comfort to their friends, as it saves the latter a painful effort to talk.

What form of hearing-trumpet is the best cannot be described here, as different patients require different forms of trumpets, tubes, etc. The best plan for a deaf person to adopt in choosing this instrument is to go to a reliable instrument maker, and try the samples until he finds one that makes him hear well. Some kinds of deafness, as those where the nerve is paralyzed by a blow on the head or by disease in the brain, no trumpet can help.

All instruments of any value must, from the nature of acoustics, have a certain size, and hence must be plainly visible; otherwise they will not augment the sound by resonance. Hence, all invisible auricles, etc., are self-evident frauds, as they are too small to augment sound. The very small gold and silver tubes, or 'auricles,' as they are called, are very expensive, and, save in the collapse of the auditory canal in old people, are utterly useless.

They are, in fact, worse than useless in all cases but those mentioned, since they fill up the ear and render the patient deafer.

False drums act in the same way excepting where the natural drum is perforated. To employ them, therefore, in catarrhal deafness, when the natural drum is thicker than usual, is, of course, to make matters worse. It amounts to filling the ear with a foreign obstruction."

PART IV.

PATHOLOGY.

PATHOLOGICAL OBSERVATIONS.

"MALFORMATIONS OF THE EXTERNAL EAR," says Toynbee, "generally co-exist with partial or entire absence of the meatus. Sometimes the tragus is pressed backwards and inwards so as to close the meatus; in such a case the patient must wear habitually a small silver tube or have a portion of the tragus excised. A much more serious malformation, and unfortunately one that is not uncommon, consists in the absence of the cartilage of the external ear, together with the external meatus; the only representative of these parts being one or more soft and shapeless duplicatures of the integuments; sometimes, indeed, there is no vestige of either meatus or auricle."

The author, while preparing this article, was consulted by a gentleman 35 years of age, (a resident of this city,) whose left auricle is imperforate, though otherwise not malformed, save the absence of the lobule. There is complete closure of the external meatus, but a very small perforation appears immediately at the lower part of the *antihelix*. Upon examining this opening with a small silver probe I ascertained the depth to be half an inch and sacciform, but not communicating with the meatus within, or supposed meatus. This everted pocket or sack seems to be supplied with ceruminous glands, as I noticed a small quantity of healthy looking cerumen adhering to the probe as I withdrew it. The closure of the meatus, in my opinion, does not extend far within or beyond the integument, inasmuch as the voice, close by, if raised slightly, is plainly heard, indicating a normal condition of the inner organ, though words could not be distinguished. Vibrations of the tuning-fork close by were also plainly heard. I proposed an operation, to which the patient replied: "I think some future day I will let you try what may be done."

A case is cited by Mr. S. Cooper (loc. cit. p. 470) of a child he saw, when it was exhibited in London as a curiosity, which was wholly destitute of external ears, and in whom no meatus auditorii were visible. The child, nevertheless, 'could hear a great deal, although the sense was certainly dull and imperfect.' No careful investigation seems to have been made of this case, nor is it stated whether the presence of any meatus auditorii could be detected through the integuments. Judging from somewhat analogous cases which will be cited, it is most probable that the meatus was entirely absent.

Fritelli and Overteuffer are also quoted by Cooper, as having seen cases in which the outer ear was entirely absent. The former says that the physiognomy of the child resembled that of an ape, and the latter states that his patient heard very well. In some instances the auricle is deformed without any abnormal condition of the meatus or tympanum; but, as a general rule, malformation of the external ear is accompanied by a defective development of the meatus and tympanic cavity.

Congenital malformation of both ears, and absence of the meatus auditorii.—* "Miss A. J., aged 22, consulted me in 1851, on the recommendation of Dr. Theophilus Thompson. On examination, a very small fold of integument, in which was a delicate portion of cartilage, represented each external ear. The only vestige of the meatus auditorii was a very slight depression on each side, at the floor of which firm bone was felt. She heard the voice perfectly when spoken to loudly within a foot of the head, and best when the voice was directed towards the vertex of the head. She has a slight impediment in her speech, and her face is short and square-shaped; the zygomatic process appears to be undeveloped. When she attempts a forcible expiration with closed nostrils, she feels a sensation of pressure in both ears. Does not hear so well during a cold. Three months previously a surgeon had made a crucial incision over the depression in the left ear, but no meatus auditorius was found. The patient thought she heard slightly better while the surface was kept open, but it was found impossible to prevent it from healing. I advised that no further operation should be performed, and that she should rest content with the amount of hearing she possessed. She died about two years afterwards, but it was found impracticable to obtain a post-mortem examination.

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* Toynbee on the Diseases of the Ear, page 49.

In some instances there has evidently been a coexistent abnormal development of the labyrinth, and the patients have been wholly deaf from birth; it is gratifying, however, for the surgeon to be able to assure the friends of infants respecting whom he may be consulted, that, as a general rule, there is a sufficient development of the organ for educational purposes and the ordinary intercourse of life. Thus one of the cases seen by Dr. Allen Thomson was a boy who went on messages for his father, a butcher. He could join in the conversation of those with whom he was intimate; and even a stranger could communicate with him by employing slow, distinct, and rather loud articulation. A girl of only moderate intelligence, partly from weakness and partly from imperfect hearing, nevertheless understood what was said to her, if spoken slowly and distinctly, and always answered by speech. Attempts to improve the hearing in similar cases by means of operations have invariably been unsuccessful; first, because, as a rule, there is an entire absence of meatus and membrana tympani; and secondly, because it has been found impossible to keep the aperture in the integuments from closing. In most cases of deformity of the external ear and meatus, a peculiar square shape of the face has been observed, the lower jaw being very short; and there is also not unfrequently imperfect speech and deglutition. Thus in an infant, a month old, seen in consultation with Mr. Roberts, of St. John's Wood, 1853, the meatus auditorii being entirely absent, and the auricles only partially developed, the chin receded much more than natural, and there was a not unfrequent regurgitation through the nose of the contents of the stomach during eructation."

TUMORS.

"The tumors found in the auricle," I quote from St. John Roosa's work, "may be divided into the following classes:

I.—Fibro-cartilaginous.
II.—Sebaceous.
III.—Vascular.

The first-named form is a simple hypertrophy of the normal structure of the auricle. According to Billroth,* these tumors consist chiefly of fusiform cells and connective tissue, and are nothing more than hypertrophy of a cicatrix such as occurs on other parts of the body after injuries.

Sebaceous or fatty tumors should be removed by "enucleation," that is to say, by cutting down through the integument and shelling them out.

OTHÆMATOMATA OR VASCULAR TUMOR OF THE EAR.—"The peculiar effusion of blood which quite often occurs in the auricle," says Dr. Roosa, "and *especially* among the insane, and which is known as othæmatoma, hæmatoma auris, or vascular tumor of the auricle, has caused quite an amount of discussion among scientific observers." They may be divided into those of idiopathic and traumatic origin. The idiopathic form occurs chiefly, though not exclusively, among the insane. The vascular tumor of the auricle according to Dr. Hun's statistics, is much more common among men than women. When occurring in the insane is a symptom which is highly unfavorable, and which points to an incurable form of disease of the brain. "The tumor," says Dr. Roosa, "either ruptures spontaneously, sometimes with such violence as to spurt the blood to a distance of several feet, or unless interfered with is gradually absorbed."

Authorities differ as to the proper method of treating the idiopathic form of this affection. Dr. Hun says puncturing or laying open the sack does more harm than good, and believes that the least amount of deformity is obtained when the effusion is gradually absorbed. Dr. Gray, of the Utica Insane Asylum, proposes to ligate the posterior auricular artery. Gruber advises the evacuation of the fluid and the coagula, and the use of a compress bandage. Dr. Roosa says his experience inclines him to Gruber's method of treatment. "Vascular tumors, caused by violence," says Roosa, "should not be confounded with those occurring idiopathically."

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* General Surgical Pathology and Therapeutics, p. 551. Translated by C. E. Hackley, M. D.

MALIGNANT DISEASE.

Epithelioma.—" Common *epithelial carcinoma*, (specially so called because it was the first, and, until lately, the only form in which the main body of the cancerous tumor was known to consist of epithelium,) or *cancroid* (cancer-like tumors. This name was chosen because these cancers of the skin were considered less malignant than those forms observed in the breast, which were considered as the type of true cancer."*) The auricle is sometimes the seat of malignant disease. Dr. Roosa observed one case of epithelioma of this part in which the whole auricle was destroyed, and the disease had extended into the auditory canal. Dr. J. Orne. Green, of Boston,† also reports a case and quotes from Velpeau. This disease of the auricle usually begins as a small papule which finally developes into an open ulcer. This spreads very rapidly, involving finally the auditory canal and, unless arrested, the deeper parts.

Excision or amputation of the parts affected is regarded as the proper treatment. In the healing process care should be taken to prevent the closure of the meatus by the cicatrix.

Sarcoma.—Sarcomatous (cancerous) tumors may occur on the auricle as well as in the auditory canal. Their growth is slow, but they may extend to the auditory canal, to the middle ear, and even to the labyrinth and meningies of the brain. The only proper and safe treatment is early removal. No assurance can be given of permanent cure.

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*Billroth's Surgical Pathology, by Harkley, page 651.

†Transactions American Otological Society, 3rd year.

PART V.

THE EXAMINATION OF EAR PATIENTS.

THE EXAMINATION OF EAR PATIENTS.

The first duty of the aural surgeon, in all cases that come under his observation for treatment, is to make a *careful* examination as to the nature, location and cause of such ailment. Until this has been done, and *well done*, no correct diagnosis can be given, nor rational system of treatment adopted and pursued. It is gratifying to note that modern aural medicine and surgery is not without the necessary means and scientific appliances essential to enable us to as fully comprehend the pathological conditions of this organ, and as well, as that of any other organ or part of the body in a diseased state.

The history, pertaining to the ailment of such case as may call for treatment, should be carefully inquired into. This history should include a full statement of the general condition, the diseases from which the patient has suffered, the number of times and at what age (if ever) he has had ear-ache, and the treatment he has or had been subjected to at such times and from his earliest recollection. The age and occupation of the patient may have important bearing in the diagnosis.

The time when the troublesome symptoms were *first* observed, is of much importance. In my experience I find when patients with chronic ear ailments first apply for consultation or treatment, they are likely to date the commencement of their trouble to a period of only a few months or a year or two back, but, on closer inquiry, I find the ailment to have existed for many years; and this seems to be the experience of aurists in general, with such cases. Several reasons may be assigned for this oversight or want of apprehension on the part of such afflicted. In many instances one ear only is affected, and so long as the hearing power remains good in the other ear, the defect, in the ear affected, is unobserved until by some accident, or through some cause, the other ear becomes involved so as to interfere in the hearing of ordinary conversation, then from this period they will date the ailment to have commenced. Very frequently I am consulted by patients complaining of defective hearing in one ear, and when asked as to the hearing power of the other ear, they will tell me "that is all right," but which on examination proves to be *all wrong*, being quite deaf to the voice and to the watch.

So, likewise, when both ears become very gradually affected at the same time, the ailment is not noticed, in some instances, for many years, until by sickness, or accident, the preexisting ailment may become greatly aggravated so as to produce a marked degree of deafness. This then will be regarded as the commencement of the ear trouble. After having ascertained as accurate account as possible, the next step is to test the amount of hearing or hearing power. This may be accomplished by ordinary conversation, by the tick of the watch, and by the tuning-fork. The first of these tests probably tells most about a person's practical hearing power, and yet it is the most difficult to carry out. There are many persons who can hear the tick of a watch but a short distance, (six or eight inches,) and yet are able to hear ordinary conversation, and on the other hand, there are others who can hear the same watch tick twice as far but who are quite unable to understand what is said when spoken in an ordinary tone.

THE VOICE TEST.

One of the best tests we have for ascertaining the hearing power, is the one which shows the patient's capability for hearing what is said in social intercourse; but to ascertain at what distance words can be understood when they are directed to such person, his face should be so placed as not to see the mouth of the speaker, since all persons with impaired hearing soon learn to watch the lips of the speaker in order to comprehend more readily what is being said.

THE WATCH TEST.

As stated, a person may be found, who, though unable to hear a loudly-ticking watch more than a few inches from the ear, is hardly perceptibly deaf to conversation ; and again, a person whose hearing is very considerably impaired for general sounds, will sometimes be able to hear a watch at many inches from the ear. The watch-tick, therefore, is not a reliable test of the hearing power or appliance by which to ascertain the exact degree of deafness, but a very convenient and valuable *aid* in ascertaining such power, and especially in estimating changes in degrees of hearing in a patient under treatment who is seen from time to time, notwithstanding its insufficiency on account of its possessing but one or two tones, which convey only separate shocks to the auditory nerve.

In stating the hearing distance by the watch the suggestion of Dr. J. S. Prout, of New York, seems very desirable to be adopted. It is to give, not the number of inches it is heard but the fraction of the *average* or *normal* distance, in using this *normal* distance as the denominator. Thus the hearing distance by an ordinary watch is about *forty* inches, and accordingly we should describe the hearing of a patient who heard at *six* inches as $\frac{6}{40}$; and of one who heard the tick only when the watch was placed against the ear as $\frac{0}{40}$.

It should be remembered in respect to the watch, that its tick is louder in proportion as it has been recently wound up. In testing the hearing by means of the watch it should first be placed at a distance at which its ticking cannot be heard by the patient and then gradually approached to a situation where the ticks can be accurately counted. The latter may fairly be considered as the farthest point of distinct hearing.

THE TUNING-FORK TEST.

* " Next to the voice, and, indeed, superior to it for some purposes, stands the tuning-fork. We owe the first scientific appreciation of the value of this test to Lucae, who began his investigations by a study of the reason for which a tuning-fork vibrating on the head is heard better if the meatus is closed. The balance of opinion on this point appears to be that the vibrations, which would otherwise escape through the meatus, are thrown back upon the tympanum and labyrinth and so increase the hearing; but Lucae prefers to ascribe it to a gentle pressure exerted on the labyrinth by the closure of the passage. However this may

be, the information practically conveyed by this simple circumstance is of immense value. In one-sided deafness there is at hand a simple, and in the main, most reliable test for the most fundamental of all questions as regards prognosis, namely, whether the affection is confined to the conducting media or involves also the nervous apparatus. In any case in which one ear alone is affected, or one ear markedly more than the other, it suffices to place a vibrating tuning-fork on any part of the mesial line of the skull, and ascertain, with due precautions for accuracy, from the patient whether it is heard louder on the worse or the better side, at once to form a rough classification of the disease. If better on the worse side it depends on obstruction to the passage of vibrations; if better on the better side the nerve is probably at fault. Even when there is reason to believe in the existence of a nerve affection of both sides, if the tuning-fork be heard louder on the worse side we may still infer that the difference between the two ears is (partly at least) due to the lesion of the conducting apparatus on the more affected side. It is necessary, of course, thoroughly to guard against the tendency of the patient to say what he expects to feel instead of what he really experiences; a tendency intensely strong even in the most cultivated classes. I much prefer to place the tuning-fork upon the teeth rather than on the vertex, and it is best placed on the lower teeth, the mouth being closed. The sound seems to be conveyed with much more certainty to the auditory nerve through the teeth than through the bones of the head in any other way. Many patients, I find, will hear it well on the teeth, and yet very imperfectly when placed on the vertex, so that while its being heard but a short time in the latter situation affords no real evidence that the nerve-power is impaired, I am inclined to believe that its being heard but a short time when fairly applied to the teeth is very strong evidence that the nerve has suffered. But the value of the tuning-fork in this respect is less negative than positive. Whatever the other symptoms may be, if the tuning-fork is well heard when placed upon the middle line of the teeth, we seem to be justified in holding that the disease is one that leaves the auditory nerve unimpeded in its functions.

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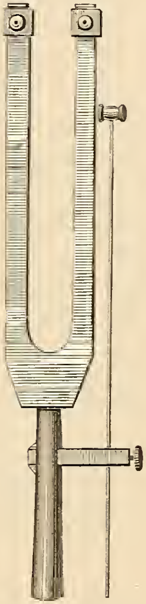
* Hinton's Aural Surgery, page 58.

It must not, however, be inferred that always when the tuning-fork is heard worst on the most affected side the nerve is implicated.

Cases have occurred to me and others in which, even when this symptom existed in the most distinct manner, treatment adapted to remove mucous from clogging the ossicula was thoroughly successful.

FIG. 5.



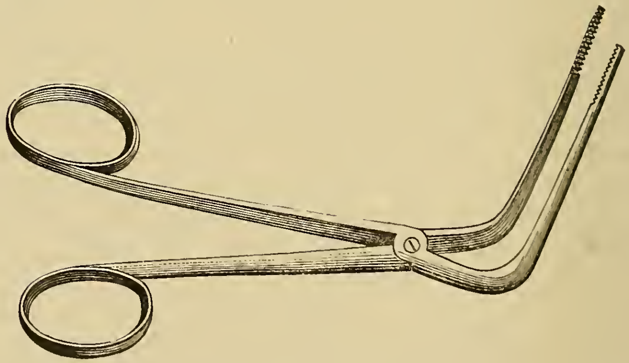
In testing the amount of hearing by the tuning-fork, it seems to me the best plan is to transfer it rapidly from the patient's teeth to one's own, having first ascertained that one's own hearing of it is fairly keen. It has been suggested by Von Conta, however, to strike the fork with a definite degree of force and to note the number of seconds it is heard, having, of course, practiced the hand in striking uniformly and discovered the normal duration of the sound. It is good to have various tuning-forks, as the results are not always exactly the same with different ones; and, indeed, I have been, in rare cases, unable entirely to reconcile them. But the same fork made with a strong *clamp* will give any note, and one has been constructed by Dr. Blake, of Boston, with a small hammer attached, the force of the blow of which may be estimated by a dial. (Fig. 5.)

But it is through observing the effects which closure of the meatus produces upon its sound that the chief value of the tuning-fork is gained. The closure may either (1) increase the sound, or (2) may have no effect upon it, or (3), in some rare cases, may diminish it. The mode of testing is to press the tragus lightly, but firmly, back, occluding the passage, but avoiding pressure upon it, unless it is expressly intended to note the effects of pressure. The normal reaction is to increase the sound; this denotes, so far, absence of obstruction to the passage of sound; if the increase be very great—'doubling the sound,' the patient will sometimes say—we may infer that the meatus and tympanum are for functional purposes healthy. If the closure produces no effect upon the sound, or in so far as the increase is of less than the normal amount, it indicates that sound does not pass as it should through the tympanum, and examination will almost always reveal the fact of some hindrance. It is, therefore, *a good sign* in any case of deafness that closing the meatus should have no effect upon the sound of a tuning-fork placed on the head or teeth, because it affords presumptive evidence that the lesion lies not deeper than the tympanum. It is held by one eminent authority,* that in purely nervous affections closure of the meatus does not increase the sound of the tuning-fork placed on the head or teeth. This is a point worthy of all examination. My experience had led me to the contrary conclusion; and in cases, that on other grounds I diagnose as nerve-affections, I tend to hold the patient's hearing the tuning-fork better with the meatus closed to be a confirming stroke to my opinion of his unhappy state, as indicating that the source of his affection lies deeper than the tympanum. (3) Rarely, as said, closing the meatus diminishes the hearing of the tuning-fork. On this point clinical experience gives us as yet scanty data."

EXAMINATION OF THE AUDITORY CANAL AND DRUM MEMBRANE.

The next step after noting the hearing power is the exploration of the auditory canal and membrana tympani (drum-head).

Fig. 6.



Toynbee's angular forceps.

To accomplish this successfully, three instruments are necessary. A pair of angular forceps, an ear speculum and a concave mirror or reflector. The appliances necessary for syringing the ear should also be at hand.

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* Dr. Roosa, of New York. See his 'Diseases of the Ear,' p. 488. I am not aware of any other statement to the same effect.

The forceps may be needed to remove any temporary obstructions which may prevent a view. The speculum dilates the passage, and the mirror throws the light into and beyond it.

EAR SPECULA.

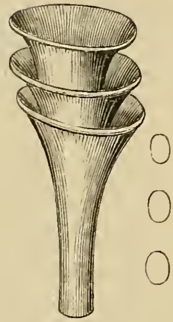
Different varieties of specula have been brought into notice since the time when Gruber and Wilde first introduced theirs to the notice of the profession. For practical purposes either those known as Toynbee's (*vide* plate), or modifications of them, as Turner's, will be found quite sufficient. Some surgeons prefer specula with an opening at the side to facilitate examination of the meatus and for therapeutical purposes, or as recommended by Hinton, a speculum with a small piece out of the end in order that a more perfect view of the membrane may be obtained. The figures following represent some of the best known kinds of specula, and I will only add that the utility of a speculum does not depend so much on its form or shape as on the hand that guides it. For children it is necessary to have a speculum with a small, and, I prefer, a perfectly circular tubular end.

As the first essential towards successfully introducing the speculum in the adult, we must keep in mind the length and direction of the external auditory canal.

We have now to place our patient in a good position for examination and to introduce the speculum. Hinton says "ordinary daylight gives the most distinct illumination;" next to that I prefer a properly adjusted gas-light. "A beautiful view of the membrane," says Jones, "may be obtained by means of sunlight, but the light must be thrown rather on the wall of the meatus than directly on the membrane, as by its intensity it dazzles and prevents us seeing distinctly." We now proceed to introduce the speculum; in doing so the auricle should be pulled upwards with the left hand. Here we must remember the great timidity which many patients exhibit on being examined. Therefore it is that a light and gentle yet firm hand is required to conduct all aural manipulations. In many affections of the auricle and meatus there is superadded to the natural sensitiveness an inflammatory state which

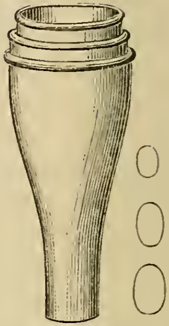
SPECULA.

Fig. 7.



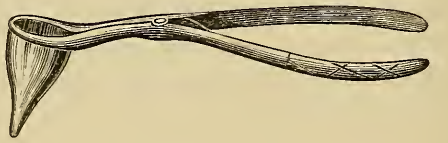
Turner's.

Fig. 8.



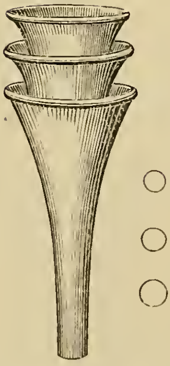
Gruber's.

Fig 9.



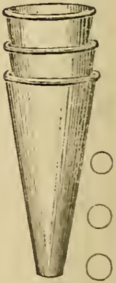
Kraemer's bivalve speculum.

Fig. 10.



Toynbee's.

Fig. 11.



Politzer's.

makes the handling of the ear a thing to be avoided as much as possible. Rough pulling of the auricle or any forcible pushing of the speculum is sure to be resisted by the patient, who may perhaps be alarmed at any further interference, but in any case of aural affection all force or roughness is to be deprecated. Those who cannot manipulate with gentleness had better not manipulate at all. *"A man's entire success with a patient will depend much on the confidence and ease with which he introduces the speculum or the Eustachian catheter; the infliction of unnecessary pain under any circumstances should be avoided. This preliminary can only be secured by keeping constantly in mind, and strictly adhering to the resolution, to *avoid all force.* It is to the rigid carrying out of this principle that most men owe that delicacy of touch which comes from the constant treatment of all delicate organs—no rough or awkward surgeon will ever make an aurist."

†"In introducing the speculum," says Hinton, "it must be remembered that (beginning from without) the meatus winds, first, a little forwards and then backwards, and slightly upwards, so that there is a tendency for the eye to fall on the wall of the meatus, instead of reaching the membrane; and the speculum accordingly must be introduced well into the passage, and directed first a little forwards, for the most part with a slight pressure on the outer part of the posterior wall, to straighten the cartilaginous portion of the canal. This will be much aided by drawing the auricle slightly upwards and backwards with the left hand." We can reverse hands according to the ear examined and the position of the patient.

"In very young children the inner half of the exceedingly narrow meatus has scarcely any open calibre, since the membrane, which lies horizontally, is in contact in its whole extent with the membraneous floor of the meatus, this contact being due in part to the fact that the epidermis covering the membrane has at this time very considerable thickness.

Having introduced the speculum well into the meatus, we note its shape and size, if narrowed and painful; if the dermis is congested or inflamed; if there is any discharge, and if so, its colour, nature, or smell; if there is a collection of cerumen which interferes with our view of the membrani tympani. If there is any pus or epithelium which blocks up the meatus, it must be carefully removed with the syringe, and the passage cleaned with a little cotton wool rolled on a probe or iris-hook. The canal can then be examined thoroughly for foreign bodies, polypi, molluscous or sebaceous tumors, fungi, exostoses, &c."

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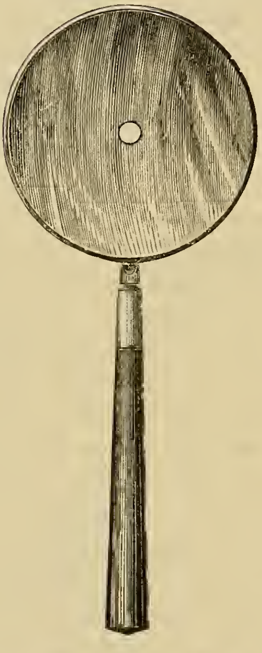
* Jones' Aural Surgery, page 28.

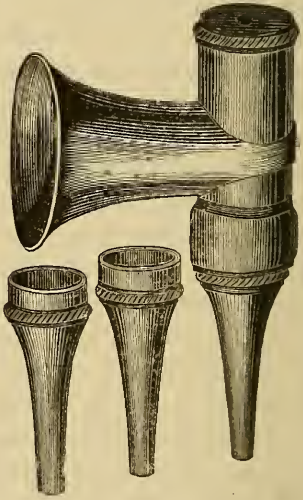
† Hinton's Aural Surgery, page 23.

FIG. 12.



VON TROLTSCH'S OTOSCOPE OR MIRROR.

FIG. 13.



BRUNTON'S OTOSCOPE.

*"Having thus dilated the canal, the light may be thrown into it by means of the otoscope or reflector of Von Tröltsch, which is a concave mirror of about three inches in diameter, having a focal distance of about six inches. Ordinary daylight is the best source of illumination for this mirror, although sun light, lamp light, gas light, that of a candle, or the reflection from a light-colored wall,

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* St. John Roosa's Treatise on the Ear, page 81.

may each be made available in this method of examining the outer parts of the ear. This is a very simple process, although many make a difficult one of it. If we but use the skill we acquired in our juvenile days in throwing a dazzling light upon a desired object by means of a bit of broken mirror, it will serve us in good stead here. The mirror is held very lightly in the hand, and the light is condensed upon any desired part by a very slight movement."

When it is desirable for both hands to be free, as in any operative proceeding, it is worn on the forehead and fastened round the head with a band or handkerchief.

"It is now almost universally conceded by the profession, that this method is altogether the best that has yet been suggested for the examination of the membrana tympani. It has the unequivocal endorsement of such otologists as James Hinton of London, Schwartze of Halle, Politzer and Joseph Gruber of Vienna. It was first introduced to the profession at large by Professor Anton Von Tröltsch, in 1855, without previous knowledge that it had been suggested by others, although Dr. Hoffman, of Westphalia, had previously, in 1841, used an ordinary shaving mirror with a central opening for the examination of the ear. Professor Edward Jaeger in his work on Cataract and Cataract Operations, published in 1853, suggests that his ophthalmoscope may be used with the concave mirror of four inches focal distance for the examination of the external auditory canal. I have also been informed by numerous practioners that they have often used the ophthalmoscopic mirror for examining the ear; but in spite of all these statements, and the fact that Frank,* in his work on the Ear, gives a sketch of Hoffman's otoscope, the credit of the introduction into general use of the concave mirror for the examination of the ear as certainly belongs to Von Tröltsch, as the invention of the ophthalmoscope to Heinrich Helmholtz. It is somewhat surprising, however, that after the description which Frank gives in his text-book of Hoffman's method, and the drawing which he furnishes of the mirror, no attention was paid to the subject until Von Tröltsch revived it, without knowing of Hoffman's apparatus.

I introduced the use of the aural mirror, or otoscope as it should be called, into the practice of the New York Eye and Ear Infirmary, in 1863, where it soon superseded all other methods, and whence it has been very generally adopted in the United States.

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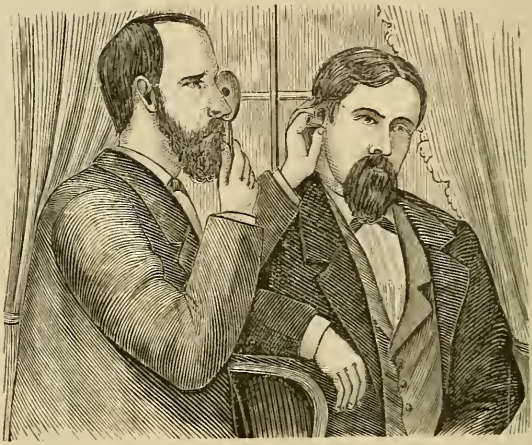
* Practische Anleitung, zur Erkentniss der Ohrenheilkunde, p. 49.

It may be safely said that the adoption of this simple method of examination has done more for the scientific and practical study of aural disease than any previous suggestion in this department. It has placed within the hands of every practitioner a method by which he may, in a few minutes, learn to examine a membrane which not a few physicians had never seen on a living subject."

Fig. 14.



METHOD OF EXAMINING THE EAR.

THE MEMBRANA TYMPANI OR DRUM-HEAD.

We now examine the membrana tympani or drum-head and bring into view as clearly and distinctly as possible this membrane and ascertain whether any signs characteristic of disease present themselves, or whether the structure is perfectly healthy. The anatomical characters of the membrane, when in a healthy or normal state, should be well understood in order to be able to detect any pathological changes that may have taken place in its structure.

The healthy membrana tympani is translucent and concave. It is placed at an angle of 140 degrees and fixed to the temporal bone at its circumference, and by its centre to the handle of the malleus.

At this point, where the short process terminates, we notice the most concave portion of the membrane, and here we notice the well-known "bright spot," which gives to the membrane that beautiful and lustrous appearance when light is thrown upon it by the mirror. The bright spot has its base generally directed downwards, but its position and extent are variable, and it is by no means uncommon to find its usual shape altogether lost, or there may possibly be no bright spot in an ear in which the hearing power is perfectly normal. It serves as a delicate indication of the degree of mobility of the membrane, as it is variously altered when the membrane is forcibly inflated. In a normal state this spot partially disappears on inflation, and the funnel-shaped depression underneath it is bulged outwards.

*"The short process of the malleus is also of considerable importance in a diagnostic point of view, for it separates, as described by Tröltsch, the inferior from the posterior pocket of the membrane, the posterior being over, the anterior under the short process. These pockets are formed by the ligamentous folds of mucous membrane or prolongations of the ligamentum mallei anterius. They are of clinical importance, as it is now recognized that here the secretion of mucus is retained (Hinton), and that they are the source of the bulgings of the membrane which we so frequently see when this retention occurs. We may now seek to satisfy ourselves on the following points: (*a*) the appearance and position of the handle of the malleus, if drawn inwards and 'shortened in perspective' (Tröltsch); if it appear unusually prominent or altogether displaced and dislocated from its natural position; if it is vascular with vessels on the surface, and presents a red appearance; (*b*) the triangular spot, if present, its direction and lustre; if the cone has lost its distinctive shape, or if there are two or more of these distinctive spots of light; (*c*) the general color and appearance of the membrane itself; its degree of curvature, opacity, and thickening; the degree of mobility on inflation; the signs of any deposits, calcareous or otherwise; the presence of polypus; if there be pulsation, rupture, or perforation."

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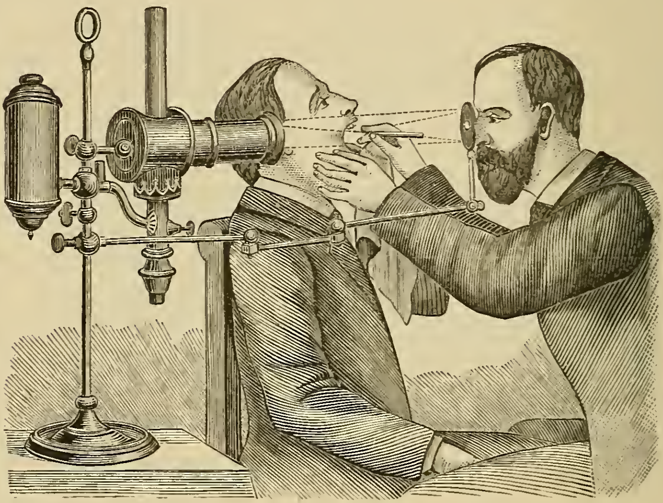
* Jones' Aural Surgery, page 33.

THE THROAT.

EXAMINATION OF THE PHARYNX AND MOUTHS OF THE EUSTACHIAN TUBES must not be overlooked, since a very large percentage of aural cases have their starting-point in these parts.

The patient's face should be turned toward the light and the tongue depressed by a hinge speculum or other means. Artificial light may be preferred, and at night time is indispensable. A reflector attached to a forehead band may then be used, or Tobold's Laryngoscope and Lamp.

FIG. 15



TOBOLD'S LARGE LARYNGOSCOPE AND LAMP.

*"The brilliant successes in laryngoscopic surgery have been duly proclaimed in current medical literature, and have stimulated many professional laborers to engage in the development of the same field of usefulness. The first decade of laryngoscopic research has but recently passed its completion, and already the laurels which it has added to the crown of Æsculapius are equal in freshness, imperishability, and gracefulness to those culled in any other portion of his broad domain.

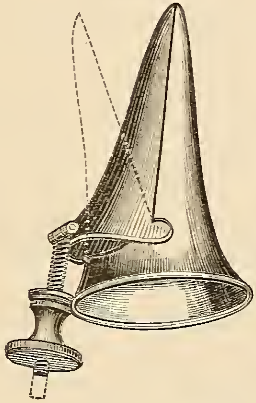
The literature which laryngoscopic observation has tendered for perusal during these ten or twelve years is very extensive, and the lessons it has taught have won for it a distinguished position among the valued records of medical and surgical learning."

* Cohen, Diseases of the Throat, page 12.

THE NOSE.

The examination of the nostrils is often an important part of the examination of a case of ear disease. By placing the patient in front of a good light, and pressing the tip of the nose to open the nares, may suffice to get a view of the anterior parts. If an instrument be necessary, the one represented in Fig. 16 will be found to answer every purpose.

Fig. 16.



Duplay's nasal speculum.

Rhinoscopy was first introduced into general use as a practical method of examining the posterior nares by *Professor Czermak*, of Prague. For the practice of rhinoscopy a good artificial light of some kind, a small mirror, or a Tobold's lamp, a tongue spatula and a concave mirror that may be attached to a forehead band are needed. These appliances after some experience with them will be found to greatly aid in the inspection of the posterior nares.

EXAMINATION OF THE EUSTACHIAN TUBE.

The means by which this examination is usually made may be classified as follows:

I.—The Eustachian Catheter.
II.—The Otoscope.
III.—Politzer's Method.

THE EUSTACHIAN CATHETER.

*"The chief facts of practical importance which we have to recollect when we undertake the passage of the catheter are as follows:—The Eustachian tube is about one inch and a half in length ('35 mm.; 24 mm. of which belong to the cartilaginous, 11 mm. to the osseous canal,' Tröltsch translated by Hinton), the osseous portion in the temporal bone being three-quarters of an inch, and the cartilaginous portion one inch. The tube is funnel-shaped, its narrowest part being

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*Jones' Aural Surgery, page 52.

at the junction of the osseous with the cartilaginous portion. This tube passes from the anterior wall of the tympanum downwards, forwards and inwards, to terminate at the pharyngeal orifice, which projects as the opening of the trumpet, close behind the internal pterygoid plate, on a level with the inferior turbinated bone, at the back part of the inferior meatus of the nose. Two lips bound this orifice, one posterior, directed downwards, the other anterior, turned upwards. It measures (Tröltsch) '9 mm. in height, 5 mm. in width.' This faucial orifice (Toynbee) is nearly half an inch long. The pharyngeal end is the widest portion of the canal, and is composed both of cartilage and fibrous membrane. The mucous surfaces of the membrane which line this canal are in a state of apposition, the two patent points being the faucial orifice and the commencement of the osseous portion (Tröltsch). This arrangement converts the Eustachian tube into a form of valve, which in a state of rest is closed, and which opens and closes at each act of deglutition, in consequence of the action of the tensor and levator palati muscles, the former dilating the opening (Rüdinger and Tröltsch), the latter muscle drawing the inferior curved edge of the orifice of the tube into a straight line upwards. The palato-pharyngeal muscle assists in fixing the cartilaginous portion. This action we are frequently performing in the swallowing of our saliva. It is this action of the palatal muscles that we take advantage of in Politzerising and inflating the membrane, during the act of swallowing the water; the orifices of the Eustachian tubes then becoming pervious. We may epitomise the uses of the valvular canal thus:—

1. It permits of an exchange of air to the cavity of the tympanum; thus it forms an outlet for abnormal secretions and prevents their accumulation in the tympanum.

2. It prevents the rarefaction of the air in the tympanum by the successive acts of swallowing when air can enter the cavity at each act.

3. It maintains a condition of equilibrium between the air in the tympanum and the atmosphere.

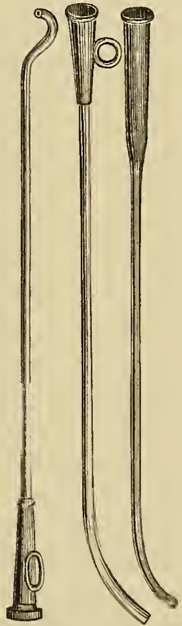
4. It may influence the vibration of the membrane and the resulting sonorous effects on the tympanic cavity (Bernstein): clinical analysis would appear to verify this suggestion.

The valvular action of the tube has the most important bearing on our knowledge of Eustachian deafness. Closure or occlusion of the tube leads to rarefaction of the air in the tympanum, which, while it may filter out, is not restored or renewed. Then follows an accumulation of mucus in the tympanum, and an increased concavity of the membrane, and finally inspissation of the secretion, contraction of the membrana tympani, and thickening and adhesion of the membrane lining the cavity with accompanying changes in the ossicles. Fig. 17 represents a form of the Eustachian catheter, the double curved catheter of Dr. Noyes of New York. The mode of passing the catheter we shall now proceed to consider.

I prefer the silver catheter to the vulcanite one. I use a smaller catheter than that generally sold, for children, and a very fine one, in cases of obstruction. It will be found useful to have catheters of various sizes and curves ready at hand. Both the vulcanite and the silver instruments can be curved to suit each case, as they are readily bent, the former being first placed in a little hot water to soften them. It is a matter for surprise that so many surgeons still fear to practise catheterisation of the Eustachian tube. It is true that it requires some little experience to introduce the instrument with ease and celerity; but with ordinary care and tact no harm can be inflicted in its passage, and there is nothing in the operation which a little practice will not enable every one who possesses any manipulative skill to overcome. The errors which I have seen generally committed by beginners are these:—The catheter is taken hold of in too clumsy a manner, and held too firmly during its introduction; it is introduced too slowly; carried into the middle meatus instead of the inferior; it is not passed far enough back, and it is turned towards the ear, anterior to the orifice of the tube; or, on the other hand, it is passed back to the pharynx, and not drawn sufficiently forwards, thereby being turned into the fossa of Rosenmüller behind the faucial orifice of the tube. The essentials to success are—a thorough knowledge of the situation of the opening; a light hold of the instrument, which we introduce with the forefinger and thumb of *either* hand; that the beak of the catheter should be directed well downwards, and then glided along the floor of the nares, keeping it away from the turbinated bone; lastly, tact in avoiding the fossa posterior to the pharyngeal orifice of the tube.

It is of importance to be able to pass the catheter with either hand with facility. Frequently a patient, just as he finds the sensitive anterior part of the nose touched by the catheter, raises his hand to catch the operator's. It is well to have the left hand in readiness, so that while we restrain the patient with the right, we continue quickly the passage of the catheter with the left hand, which we transfer to it. It is necessary, also, to avoid all useless fuss in cases where we desire to employ the instrument. The catheter should be in the Eustachian tube almost as soon as the patient becomes aware of your intention to introduce it. I now give the description of the best method of introducing the Eustachian catheter. The plan is that which is generally adopted, and is a combination of the methods recommended by Krämer, Tröltsch, Politzer, Löwenburg, and Hinton.

Fig. 17.



EUSTACHIAN CATHETERS.

The catheter, held lightly between the forefinger and thumb of the right hand, the left being in readiness to transfer to it, has its curved point, directed downwards, introduced into the nostril; the hand being then raised, the catheter is carried quickly, unless there be any obstruction, *horizontally* along the floor of the nares, all force being avoided, until the pharynx is touched posteriorly. The instrument is then drawn gently forwards, about half an inch, at the same time that it is rotated upwards and outwards, until we know by the direction of the ring on the outer end that it is turned towards the ear. It is then felt in the tube having ridden over the posterior lip, and we verify the success of the operation by inflation. Löwenberg and Politzer recommend a plan which it is well sometimes to adopt, if we miss the orifice, namely, to turn the catheter in, withdrawing it from the pharynx inwards, with its point in a direction downwards, until we feel it against the septum, and then by rotating the catheter outwards and upwards, to turn it towards the Eustachian tube. Unavoidable difficulties are sometimes met with in the nares, such as abnormalities in the turbinated bone and the septum, or hardened masses of mucus. The ingenious device of Dr. Noyes, who, some years since, introduced the catheter with the double curve for right and left tube (Fig. 17), enables us as a rule to disregard these obstacles, as it is seldom that both nostrils are affected in this way, and by this modification we can readily catheterise through the opposite one. The catheter is held in the right hand for the right nostril, and *vice versa*, at a right angle to the nose, on a line with the floor of the meatus, the back of the hand being turned upwards, the beak of the catheter is introduced at the inner side of the corresponding nostril. The catheter, kept close by the septum, is carried for a short distance backwards, when the hand is brought down, the direction of the catheter being gradually changed to that of the horizontal one maintained in passing the ordinary catheter. With a sweep it is carried round the septum posteriorly, and then rotated inwards, the point readily entering the Eustachian tube of the opposite ear.

I have been using these instruments of Dr. Noyes for a considerable time, and I am constantly enabled with them to catheterise cases which would prove very troublesome, if not impossible, to manage without their assistance. The catheter being in the tube, the otoscope, one end of which has been previously fixed in the affected ear of the patient, has now the other end placed in the ear of the surgeon, and by gently blowing through the catheter with the mouth, or through a tube attached to the catheter, or the Eustachian explorer, the air is heard as if it were blown directly through the otoscope to the surgeon's ear."

"In some persons, where the nostril is sensitive, tender, or obstructed, I find it useful to pass a soft bulbous bougie, well oiled, once or twice before introducing the catheter. A patient who has been a few times catheterised, can tell immediately when the tube is entered and the membrane inflated. Such persons, who are accustomed to the instrument, are the best for beginners to examine, as they are less sensitive, bear the operation well, and can at once tell when it is successfully performed. Double catheters are made on the same principle as those used for washing out the bladder. With these instruments the cavity of the tympanum can be washed out with any solution we please to employ, a continuous stream being thus secured to carry off any secretion which we wish to displace."

Finally, it is not right to use any instruments, throat or ear, which have been used promiscuously with several patients, or at any time in any suspicious case, or where there has been discharge, without first thoroughly cleansing such by dipping them into boiling water, or some disinfectant solution. It is unfair to the patient, and lays the medical man open to the charge of being the cause of transmitting a disease.

We shall consider, further, the various methods of dilating the Eustachian tube, and the application of medicated solutions or vapours to it, or the tympanum, when discussing the treatment of their diseased conditions. In inflating through the Eustachian catheter for diagnostic purposes, I generally blow directly through the tube, applying my lips to the catheter. From long experience of this method I may say that I am quite satisfied with the knowledge that it in nearly every case conveys to me. I believe that if any one educate his ear to the sounds conveyed by the passage of the breath in the various abnormal states of the membrane, the Eustachian tube, and the cavity of the tympanum, which require the employment of the catheter, we can gain but slight additional information from any bag or insufflator which may be used.

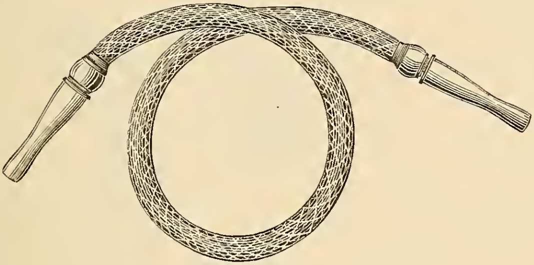
THE OTOSCOPE OR DIAGNOSTIC TUBE.

We detect the patient's power to inflate the membrane by means of the otoscope or diagnostic tube (Fig. 18). This simple contrivance also enables us to arrive at a conclusion as to the state of the Eustachian tube. The otoscope of Politzer is a simple india-rubber tube, having a small vulcanite ear-piece fixed at the end. Three tubes may be had connected to a central hollow vulcanite ball. This form is convenient, as the patient can place a tube in each ear, and the result of the inflation of the two membranes can be contrasted. It is also useful for teaching purposes, as a student can examine the ear with it at the same time as the surgeon. By placing a tube in either ear of the surgeon, the intensity with which the sound is conveyed is increased, and the least inflation perceived. Double German otoscopes, on the principle of the double stethoscope of Scott

Alison, have been contrived and used by Lucae and Turnbull. Of these I have no experience.

The mode of using the otoscope is simple. The patient is desired to shut his mouth, and at the same time to hold his nose firmly, and then to blow (not too forcibly), when the air is at once heard with a gentle rustle impinging against the membrane. The previous insertion of the speculum when this is done will show the degree to which the patient can inflate the membrane. In the majority of cases we recognise the fact that air has impinged by an alteration in the shape of the membrane or any temporary obliteration of the triangular spot. But there are extremes of rigidity or flaccidity, in which it is hardly affected, or it is blown out bladder-like, and yields abnormally to the force of the entering current. We may get a peculiar moist gurgling sound of varying shades of intensity, denoting a moist state of the Eustachian tube, and probably an accumulation of mucus in the tympanic cavity. On the other hand, there is in many cases of old tympanic mischief a dry crackling sound, which accompanies that flaccidity of the membrane above-mentioned, and which I have found present in long-standing cases of retained secretion. But familiarity with these various sounds is to be gained only from the constant use of the otoscope; they are to be learned not from description, but from practice.

FIG. 18.



OTOSCOPE OR DIAGNOSTIC TUBE.

POLITZER'S METHOD OF INFLATING THE EAR.

*"The next means of examining the condition of the Eustachian tube and cavity of the tympanum is named, from the gentle-

man who suggested it, Politzer's method. It is a means of diagnosis and treatment of very great value, and we owe very much to Dr. Adam Politzer, of Vienna, for this method of sending air into the middle ear.

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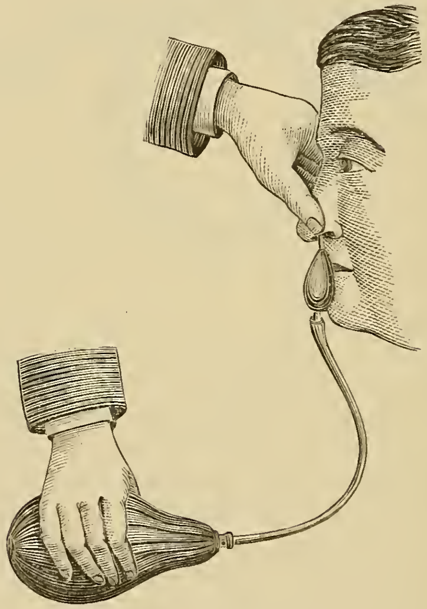
*Dr. Roosa's Treatise on the Diseases of the Ear, page 98.

As is very well known, in the action of swallowing, the uvula rests upon the pharyngeal wall so as to shut off the upper from the lower pharyngeal space; so that persons affected with cleft palate, who cannot thus separate these spaces, are greatly inconvenienced by the passage of solids and fluids upwards to the posterior nares. It was long ago shown that the pharyngeal orifice of the Eustachian tube opened during the swallowing process. Politzer's method takes advantage of these physiological facts in the following way: the person to be examined takes a little water in the mouth, while the surgeon places the nozzle of an air-bag into one of the nostrils, closes the other with the finger, and causes the patient to swallow the water at a given signal previously agreed upon, when he forces

FIG. 19.



POLITZER'S AIR-BAG APPLIED.

in the air by compressing the india-rubber bag. I usually say 'now'; upon which the patient swallows.

In examining children, I use, as suggested by Mr. Hinton, a piece of rubber tubing, and force the air from my own lungs, on giving a signal by raising the hand.

The effect of the air thus forced in upon the membrana tympani is often almost wonderful. A person who has become deaf to ordinary conversation sometimes in an instant again hears the familiar tones of human conversation, and feels himself in a new world. In such a case, mucus has usually obstructed the calibre of the tube, and is driven away by the current of air, which must of necessity go against the mouths of the tube, and will usually pass on into the middle ear. The patient's own testimony will usually, although not always, be conclusive as to whether the air entered the ear. The exceptional cases are those in which the Eustachian tube and the cavity of the tympanum have become so narrowed by a hypertrophy and sclerosis of the lining mucous membrane that only a very narrow, feeble current can enter." We shall have need to dwell upon the uses of Politzer's method when we are discussing the affections of the middle ear, and I therefore content myself with this description of it, while we pass on to Valsalva's method of inflating the ear.

VALSALVA'S METHOD.

Valsalva's method of inflating the drum consists essentially in forcing air into the ear, after a vigorous inspiration, the mouth and nostrils being closed. It has been recommended by generations of medical men as a means of curing affections of the ear, or of determining if the Eustachian tube be open, or the drum-head broken. This simple method of inflating the drum is not altogether free of harm, as the effort causes a congestion of the ear which is sometimes more or less permanent, and thereby harms the organ by increasing the flow of blood to it. Another objection to its frequent use is, it soon ceases to have its momentary effect of increasing the hearing distance, and then the membrane or drum-head becomes relaxed and flaccid. This method should therefore not be used without some caution.

PART VI.

DISEASES OF THE EXTERNAL EAR.

DISEASES OF THE EXTERNAL EAR.

INFLAMMATIONS.

Inflammations of the external auditory canal are much more rare than those of the middle ear. At one time we find the integument alone affected, at another, the periosteum and bone are involved. Firstly, if the area of inflammation be strictly circumscribed, there will be boils or abscesses in the meatus. Secondly, if such an area is not circumscribed, a larger and less definable part of the ear will be affected, and the term "diffused" may properly be applied to it.

DIFFUSE INFLAMMATION.

The diffuse form of inflammation of the external auditory meatus differs from the circumscribed, inasmuch as it does not terminate in abscess, but as its name implies is diffused throughout the integument of the canal. Since the outer cuticular layer of the tympanic membrane or drum-head is continuous with that lining the meatus, there is always a certain amount of risk lest this membrane become implicated. Children are especially liable to this ailment, and when neglected, is not unfrequently the origin of a perforation of the tympanic membrane.

Symptoms.—This ailment commences with a feeling of uneasiness and itching sensations in the canal, pain, and a sense of fullness. The parts soon become red, tender, and swollen, and there is pain during mastication. The whole ear is red and swollen, and has the appearance of standing out (so to speak) from the head. In the lower part of the canal, when the periosteum becomes involved, the pain will be intense, like that from a felon. These symptoms increase in severity until, with the appearance of a discharge, the pain ceases, and the swelling gradually subsides. Such is briefly an account of its acute stage which usually occupies a week or ten days.

Violent or prolonged suppuration of the integument may produce polypi or granulations in the external auditory canal. Two such cases having quite recently come under my observation, one a lady aged 24, the wife of an attorney, whose attending physician she informed me had applied local Faradization and after that poultices; the other a lad aged 16, of regular habits, but health somewhat reduced by indoor confinement and hard study at school. These granulations, in both cases, so much resembling polypi, developed most rapidly; in the case of the former in less than forty-eight hours sufficiently large to entirely close the meatus, but soon subsided on the application of caustic.

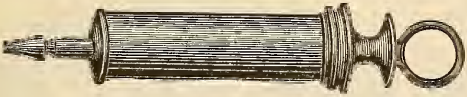
Causes.—The causes of the diffuse form of inflammation are various and sometimes obscure. Irritation of the ear by means of ear-picks, applying strong liquids and oils, such as camphorated and Harlem, are frequent causes of an inflammation of this part, especially where there has been some antecedent inflammation of the integument which causes a resort to those agents, to relieve the troublesome itching sensations—sitting in a cold draught while the body is warm and perspiring, or in a railway carriage, which is going very fast, with the ear exposed to an open window, or if the auditory canal and membrana tympani be exposed in any similar manner to a draft of air an inflammation of the canal and of the tympanic membrane may ensue.

Treatment.—If the pain be at all severe, leeches should at once be applied on the *tragus*, as *Wilde* long ago pointed out, and for the reason which Von Tröltsch gives, that in this place the vessels which supply the canal and outer layer of the membrana tympani are most conveniently and surely reached. When leeches are applied to the ear the meatus should be filled with cotton to prevent the blood from getting in. I have found scarifications of the cartilaginous wall, in the early stages of the disease, when the pain was severe, and suppuration had not yet occurred, but the auricle was red, swelled and painful, to afford very great relief most promptly. Gruber, of Vienna, recommends that these incisions should be from three-fourths to an inch long on the walls of the canal. Dr. Roosa, of New York, speaks favorably of warm water being applied by means of Clark's aural douche, or any similar means. A poultice, if applied at all, should be small so as not to cover the ear, and should never be applied to or on the ear for more than a few hours, as they relax the tissue to so great an extent as to greatly favor the growth of polypi; a small flaxseed poultice may be applied to the canal, but not to extend over the ear. After the appearance of the discharge, the meatus should be kept carefully cleansed by syringing every day. To guard against this affection becoming chronic, the state of the patient's health should receive careful attention, the diet should be attended to and a change of air if necessary.

In my opinion, chronic suppuration from the external auditory canal is quite rare in cases that have received proper attention during the acute stage. When it does occur our duty is to limit the suppuration. To this end thorough cleansing with syringe is indispensable. After the ear has been thoroughly cleansed by syringing, weak astringent lotions will be found useful and effectual in checking the ulceration and restoring the parts to health.

APPLIANCES NECESSARY FOR PROPERLY SYRINGING THE EAR.—It may be in order here to say a word or two in reference to the appliances necessary for properly syringing the ear. A small hard-rubber syringe is, I think, the best. Davidson's or others may do equally well.

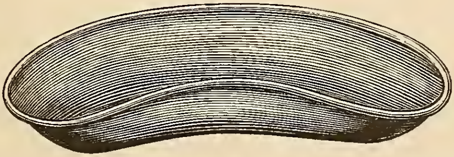
FIG. 20.



HARD-RUBBER SYRINGE.

Then we need a basin. In the absence of a pus or ear-basin, we may use a small bowl or tin cup as a receptacle for the water and pus as it runs from the ear in the process of syringing and cleans-

FIG. 21.

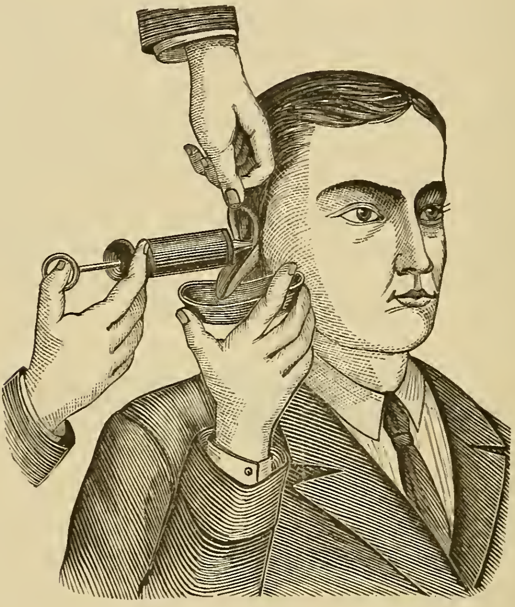


EAR-BASIN.

ing. A basin with warm water must be ready at hand, and an ear-spout to protect the patient's clothing during the operation of syringing.

METHOD OF SYRINGING THE EAR.—The patient being seated holds the basin as represented in figure below. The surgeon should then straighten the auditory canal with the left hand, and placing the nozzle of the syringe into the meatus and direct the stream with the right hand down to the membrana tympani, but always with gentleness, remembering the delicacy of the organ which, at such times as require the surgeon's attention especially, are very often in a painfully sensitive condition. No patient is capable of properly syringing his own ear. In all cases where this operation is necessary and its performance is left to a nurse or some member of a family, proper directions should be given, so that no harm may result, and that the cleansing may be thoroughly effected. The water should always be of a proper temperature (lukewarm).

FIG. 22.



METHOD OF SYRINGING THE EAR.

After the ear has been syringed, it should be wiped dry with absorbent cotton. This may be readily accomplished by twisting a small bit of this cotton on a probe or stick and then placing it carefully in the ear and giving it a light turn. This cotton answers very many useful purposes of this kind in surgery and it should always be at hand on such occasions. Common cotton will not answer at all, as it will not take up water, and a rag or the corner of a towel is too rough and should never be used in the ear.

BOILS.

Boils or furuncles in the meatus auditorius or canal of the ear give the subjects of them a great deal of pain and trouble. If they are situated near the external orifice, they are not nearly so painful as when they are somewhat further in the meatus.

Cause.—With cases of this kind we may be quite sure that there is some habit of life which wants correcting. Yet it is a singular fact that patients with this affection scarcely ever have boils in any other part of the body. Nor can we say that they are confined to persons who may be said to be unhealthy or weakly. They often occur as complications of otorrhœa. A lotion of alum appears to produce them.

Diagnosis.—This form of inflammation distinguishes itself from others in that the boil has in its centre a circumscribed "core" which is formed from dead connective tissue and also from a diseased hair cyst. The inflammation generally begins in the hair cyst, and as it develops becomes elevated and pointed about its centre, where the "core" appears.

Prognosis.—The prognosis may be said to be good, if we except therefrom the fact that often many such boils follow each other in more or less rapid succession, continuing even through a long period of time.

* "I once treated a man, who for twelve years long, with intervals of two weeks, and at the highest two months, suffered from such furuncles, now in one, now in the other ear; and with which there was always general febrile disturbance, so that at each attack

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* Dr. Anton Von Troltsch, Diseases of the Ear, translated by Dr. Roosa, page 54.

he was obliged to lie some days in bed, and thus on account of this affection hindered in his business, which was that of cattle-dealer."

TREATMENT.—*Wilde* speaks highly of the use of nitrate of silver, as an abortive remedy. If the inflammation has just begun, he thinks by this means to have often cut short the process. I have frequently had like favorable experiences, at this stage of the affection, from the careful application of a small saturated plug or roll of absorbent cotton, with the tincture of *Aconite* root, and held upon the part for a minute or two. This application may be repeated once or twice at intervals of an hour or two. Other local treatment may be found efficient or palliative. Filling the ear with warm water, with a little morphia added, will often be found to give relief from pain. Letting the steam from a vessel of warm water stream against the affected part will be found very soothing. The efficiency of this remedy may be improved by adding to the water some aromatic, as catnip, hops, &c. Poultices, if used at all, should be used with caution, as they are likely to produce granulations in the meatus. If any constitutional disturbance exists, with fever, thirst, pain and restlessness, Prof. Gross' Antimonio-Saline Mixture* will be found very efficient here, as it is in all like affections manifesting such symptoms. I find in my experience, the quicker we use the knife the better, whether pus has formed or not. By this operation the inflammatory process is cut short, or at least the further severe pain is spared the patient. The incision should be deep and free. The skin of the cartilaginous part of the auditory canal is very dense and somewhat thick, therefore the knife must be used with some force. Patients are timid about having this operation performed, as they generally are about any manipulations the surgeon may find necessary to perform about the ear; yet this timidity on the part of the patient must not deter the surgeon from performing his duty. His reputation, in the estimation of the patient at least, will be more clearly established after a clean, deep cut has been made. After the operation and the bleeding has ceased, the ear should be carefully syringed with warm water, so as to remove any blood that may have accumulated in the meatus.

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* Gross' Surgery, Vol. 1, page 103.

ABSCESS.

Cases of abscess in the meatus are sometimes very troublesome, and require much care and management. Pain in the ear is one of the first symptoms, which soon becomes so acute as to put sleep out of the question. These circumscribed abscesses may be described as swellings of varied size; flat, round in shape, of firm consistence, with broad bases, and without a well-defined border. Their color often scarcely changed from that of the skin, seldom more than a pale red, always very tender to the touch. The surrounding parts are swollen so as to partly or completely close the auditory canal. The deafness produced will be in proportion to the degree of closure of the meatus. In some cases the whole external ear will be enlarged, red, and tender to the touch. Movements of the jaw will cause much pain, and this pain always increases at night. The patient complains of extreme tension in the ear and cannot lie on the affected side, because at each motion severe pain is occasioned. In such cases, the unrest and excitement is likely to change to a state of fever or general constitutional disturbance.

Treatment.—If the patient is seen early, or within a day or two of the commencement of the attack, the greatest benefit may be afforded by placing two or three leeches in front of the tragus, just over the articulation of the lower jaw, and followed by fomentations; by these means the affection may occasionally be cut short. If not checked in the early stage, the suffering will increase in severity for several days, and, on examining with a probe, one part will be felt to be far more acutely tender than any other part of the meatus. The position of the abscess having been distinctly localized, the sooner an incision is made into it the better, as by this tension of the parts, to which the agonizing pain is due, is relieved. The best knife to use is a curved sharp-pointed bistoury, and with it a free incision should be made as it is withdrawn. But little, if any, after-dressing is required. After this the patient usually gets well in a few days. The ear should, however, always be carefully syringed with warm water after the operation. Very frequently, however, he is no sooner well of one abscess than another commences to form, and all the suffering has to be endured again. Sometimes several abscesses will occur successively in the same patient, causing an amount of suffering altogether disproportionate to the gravity of the illness. It is well always to inform the patient of the tendency of this affection to recur again and again, for unless this be done he will be likely to think the incision made for his relief was prematurely or imperfectly performed. Proper attention and advice should be given the patient in regard to his general health.

ECZEMA.

Eczema is a common affection of the outer ear, and is regarded by Tilbury Fox and by Rindfleisch as a catarrhal affection of the skin. It may be acute or chronic. After repeated attacks the auricle becomes very much thickened and the entire meatus shares in the same condition. If there is any deafness, it is only so far as may be accounted for by the narrowing of passage which takes place after the disease has lasted for a long time. It is characterized especially by an eruption in connection with more or less superficial redness, of small closely-packed vesicles, which quickly run together; the discharge of these vesicles has the peculiar property of stiffening linen. The vesicles appear in successive crops and may prolong the disease for an indefinite time. Their formation is attended with itching and local heat. The disease is very obstinate when not judiciously managed.

Treatment.—In the earlier stages the object should be to moderate inflammatory action. As a local application at this stage, the linimentum aquæ calcis is sometimes efficacious. If there be any discharge, equal parts of starch and oxide of zinc will form an excellent absorbent powder to exclude the air. This powder may be dusted over the affected portion with a camel's-hair brush. If the auricle be excoriated and sensitive, astringent solutions of sulphate of zinc may be used. When the surface is ceasing to discharge freely, or is not weeping so much, but is hot, stiff, glazy, and irritable, the following formula will be found most efficient:

℞ Hydrarg. chlorid. Mit. ʒ ij
Plumbi acetat. grs. xv
Cerat. plum subacetat ℥ j
M Ft. cerat.

This cerate may be applied to the auricle two or three times a day.

*"The local treatment of the auditory canal is often unsuccessful from the want of the personal attention of the physician. No one who is unable to examine the external opening of the ear down to the membrana tympani, can tell when it is or is not clean. Without a thorough removal of the material thrown off in an eczema, there can be no cure. An eczematous auricle may perhaps recover spontaneously, an eczematous auditory canal will, probably, never thus return to a normal condition. The material thrown off from the inflamed integument collects in the narrow passage, and by mechanical irritation increases the swelling, and produces the most troublesome symptom of the disease—deafness. The auditory canal should be therefore carefully cleansed every day with the syringe and angular forceps or cotton-holder, under a good illumination with the otoscope, and then an appropriate *liquid* application be made. A liquid preparation is to be preferred to an unctuous one, for the simple reason that an ointment will again block up the passage, and thus prevent the patient from securing the full benefit to his hearing power which the removal of the epidermis, crusts, and pus has produced. We may fail to cure many a case of disease of the integument lining this part, if we do not carry out our own advice; we should never give over the treatment into the hands of the parents or attendants of the patient, for they will be incompetent assistants.

The warm douche is very valuable in the treatment of chronic eczema of the canal. It allays itching sensations, and is usually very grateful to the patient. The use of the douche may be entrusted to the patient himself. It is well to use it very often in the early periods of treatment, say once an hour. The warm water is a direct antiphlogistic; I have seen its use alone cure most obstinate cases of inflammation of the canal, that have existed for years.

The only specific remedy for internal use in chronic eczema of the auricle, as well as that of the same disease in other parts of the body, is arsenic. In very chronic cases I usually give Fowler's solution in connection with the local treatment, and it is usually of great avail."

In connection with this local treatment, the *General Treatment* must not be overlooked. If the disease be hereditary, then a very carefully arranged plan of treatment, dietetic, hygienic and medicinal, is needed; for here the eczema has a profound hold on the system. The strumous habit must be combated wherever it is met with; and happily success is certain if cod-liver oil, steel wine, and the like are persevered with. In simple debility the mineral acids with bark, or acids and iron, should be given. At the same time, cod-liver oil is more indicated in thin and spare subjects. Rest from over-work of body and mind, change of scene, good food, &c., are also most beneficial in these cases.

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*St. John Roosa's Treatise on the Ear, page 117.

Chronic dyspepsia is very frequently present as an aggravant of eczema, and it requires all the tact of the physician to remedy it. It is in these cases that alkalies do much good in connection with bismuth, small doses of strychnine, iron, ferruginous waters, or the mineral acids as the case may be. Eczema often occurs in gouty subjects, and needs a good deal of care. If there be marked gouty symptoms, with loaded urine, the ordinary treatment for gout may be used with benefit; but in the so-called "suppressed" forms of gout the value of saline aperients, guaiacum, and iodide of potassium is incontestable. Beer must be forbidden, together with sugar, pastry, and condiments.

Nervous depression in connection with mental distress or pure excitement is common as the general condition associated with eczema. The treatment is obvious—nervine tonics. Arsenic is often beneficial in these cases; but quinine, bark, and acids, with the milder sedatives, are better. Dr. Fraser recommends in those cases in which there is marked hyperæsthesia, or to use more homely language, intolerable itching, strychnine does much good.

Under all the circumstances named, at the outset, when the inflammatory symptoms run high, salines and aperients are given first of all, in connection with local remedies to allay the inflammation. It is also very important to attend to deficient kidney action. Digitalis is here a good diuretic.

ASPERGILLUS.

Professor Schwartze of Halle,* in 1867, reported a case of inflammation of the auditory canal, in which the aspergillus was found by Prof. J. Voyd, who made the microscopic examination and established that fact. Soon after Dr. Robert Wreden * reported six cases. Since the publication of the above, cases have been reported by Drs. Roosa of New York, Orne Green and C. J. Blake of Boston, and by many others. Four cases of this fungus have come under my observation at my office during the past year. Three of these cases through the kindness of my friend Dr. Israel Cleaver, of this city, received microscopic examination, thereby establishing their identity beyond a doubt. The fourth case was not submitted to microscopic inspection, but the symptoms were all so well marked as to leave no doubt as to its identity.

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* Dr. Roosa's Treatise on the Ear, 4th Ed., page 133.

Causes.—Aspergillus or parasitic inflammation of the auditory canal is not a *primary disease*, but results from diffuse inflammation of these parts. We most frequently find it in connection with an eczema. Dr. Roosa says he has not seen a case of the growth of this vegetable fungus in which the ear was sound before the growth occurred. I may say my experience accords with his in reference to this ailment. He also says, "The fungus is actually a mould, such as clings to damp walls and adheres to bread that is not kept thorougly dry." Hence we may infer that damp and badly ventilated rooms are favorable to the production of aspergillus.

Symptoms.—There is usually a sensation of fullness in the ear, accompanied by more or less itching. There is also tinnitus aurium, vertigo, impairment of hearing, and sometimes pain, though not acute. On inspection of the meatus, whitish or blackish flakes will be found adhering to the walls of the canal, that may be readily mistaken for simple epidermis or hard wax. Sometimes these flakes or casts completely block up the whole passage. The mass is sometimes soft or lardaceous in consistence. When the casts are removed the tissue beneath is found to be reddened and tender. The growth will be found to be reproduced very soon after removal; in some cases in a few days. The *diagnosis* can only be certain after a microscopic examination of the fungus.

Several varieties of aspergillus or vegetable parasites are said to exist, but as the nature, cause and treatment is about the same in all varieties, we treat of aspergillus in general only.

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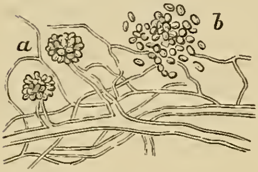
* Archiv fur Ohrenheilkunde, B. 111, p. 1.

TREATMENT.—The treatment of this fungus, or parasitic inflammation, is certainly very simple, but it is often very tedious. To remove the parasite will be relieving the most annoying symptoms, but the inflammation will often continue long after the microscope fails to find any traces of aspergillus in the auditory canal. It is well, therefore, to bear in mind in the treatment of this fungus, the pre-existing or primary affection which may require general or constitutional as well as local treatment. The ear should be thoroughly cleansed by syringing with warm water two or three times each day, and astringent lotions may be applied after each cleansing. Alcohol has its advocates, but if used at all it should first be in a diluted form, one part to three of water, which may be gradually increased in strength. Acetate of lead, sulphate of zinc, carbolic acid, tannic acid, and many other like preparations are recommended. Either, if judiciously used, will have the desired effect. Great care should always be observed in the local use of remedies to the ear.

FIG. 23.



ASPERGILLUS (after Blake).

Firstly, as to their strength, always beginning their use in a diluted form, then *gradually* increasing their strength until the desired effect is produced or their application is found inefficient.

Secondly, the *menstruum* should always be of a proper temperature, neither too hot nor too cold, as either extreme has a tendency to aggravate the evil. Lukewarm or tepid will always be found agreeable to the feelings of the patient and most beneficial in its affects.

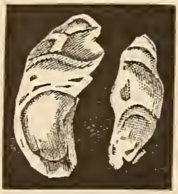
CASES OF ASPERGILLUS.

CASE I.—I was consulted in March, 1879, by a gentleman act. 56, a docter of divinity, whose general health had been somewhat reduced by too close application to his pastoral and editorial duties. He complained of his hearing being greatly impaired, and a feeling of fullness and dullness with some vertigo and tinnitus aurium, also of intolerable itching in his ears, especially at night. Upon applying the watch-test I found his hearing distance to be, with right ear $\frac{5}{40}$, with left $\frac{9}{40}$. This deafness had been coming on gradually for some months. On examination I discovered the auditory canal, of both ears, filled with a whitish lardaceous mass of decomposed epidermis. These masses I readily removed with the syringe and warm water, but on inspection of the parts after their removal, I discovered the lower part of the meatus and membrana tympani, of both ears, completely overcast with a membranous lining, parchment-like in appearance. The outer edges were irregular and somewhat detached. Warm water was again perseveringly applied with the syringe, and after some effort complete casts of these parts were removed. On inspection of the meatus and membrana tympani, after the removal of these casts, I found the surface red and very sensitive. The hearing distance, by the watch, with right ear had now increased to $\frac{15}{40}$, with left ear to $\frac{20}{40}$, which after inflation by Politzer's method, was still further increased in this ear to $\frac{26}{40}$, but only to $\frac{16}{40}$ in the right ear. There was unmistakable evidence of catarrh of the middle ear, and I regarded the affection of the auditory canal as that of an eczema, yet I suspected aspergillus. I directed the ears to be syringed with warm water, night and morning, and prescribed the following lotion to be applied warm to each ear after syringing :

℞ Zinci sulph. gr. j
Tinct opii gtt. xxv
Aqua rosae ℥ j
ℳ Ft. lot.

Patient returned in two weeks. Upon examination I found the meatus again filled with a mass as before described, and the hearing very greatly impaired. The syringe and warm water were again brought into requisition, bringing away casts as per figure here annexed (Fig. 24). The hearing power again increased to $\frac{16}{40}$ in right, and $\frac{26}{40}$ in left ear. I now prescribed as follows:

FIG. 24.



CASTS OF ASPERGILLUS.

℞ Potass, iodid ʒ ij
Tinct. colomba ℥ iv.
ℳ

A teaspoonful to be taken after each meal. The ears to be syringed with warm water night and morning, as before, and as a local application to the ear the following :

℞ Acid carbolic, gtt. j
Zinci sulph. grs. iij
Aqua rosae, ℥j.
M

To be warmed and applied after each syringing. The ear to be filled with the same and held there two or three minutes, and recommended a gargle of tannic acid and glycerine to be used three times a day. Under this treatment the patient greatly improved, but recovery was not complete until changing the local application to the ear to *alcohol dilutum.* On submitting these casts to microscopic examination they were found by Dr. Cleaver and myself to consist largely of the aspergillus fungus.

Case II.—Mrs. D—, aet. 54, consulted me July 4, 1869, on account of impaired hearing and tinnitus in right ear which, she said, had only become troublesome during the last few months. There was also a feeling of fullness with itching and some vertigo. Health fair, save slight catarrh which had existed for some time previous to the symptoms described. Hearing distance by the watch, with right ear $\frac{2}{40}$, left ear $\frac{7}{40}$. An examination of the auditory canal of right ear revealed an eczematous inflammation of these parts, with some induration and swelling at the opening or mouth of the canal. The meatus was filled with that same white lardaceous-looking substance as described in case I. This was removed with the syringe, when, on examination, the entire auditory canal was found to be inflamed and partly covered with adherent scales of dried epidermis. The membrana tympani was somewhat sunken, dry and parchment-like in appearance, no "bright spot" visible. Hearing distance now $\frac{3}{40}$. Examination of left ear revealed no objective symptoms of importance save dryness of the integument, the membrana tympani shared in this condition, and there was apparent catarrhal thickening of this membrane. On inflation by Politzer's method, the hearing distance was increased to $\frac{6}{40}$ with right ear, and to $\frac{15}{40}$ with left ear. The tinnitus was entirely removed. The patient was directed to syringe the right ear with warm water several times a day, and to apply an astringent lotion after each syringing. The aural catarrh also received attention. I have not seen the patient since, but have been informed that she is doing well under the treatment named. The morbid product was carefully examined by Dr. Cleaver, under the microscope, and found to be a specimen of aspergillus.

Case III.—The morbid product of the ear of this case, whose history was similar to those above stated, was also examined under the microscope by Dr. Cleaver of this city, and also by Dr. Tyson of the University of Pennsylvania, and pronounced "a beautiful specimen of aspergillus."

INSPISSATED CERUMEN (HARDENED WAX.)

Accumulations of wax in the ear is regarded as a very common and a very harmless affection of this organ, but any aurist of experience will say it is neither so *very* common nor so *very* harmless as is generally supposed by the laity, and also by those of the profession who do not give aural diseases proper attention. It is not a primary disease, but a symptom, therefore its removal is not always followed by relief from the symptoms supposed to have been caused by it, as the annexed tabulated statement of one hundred cases by Toynbee will show.

TOYNBEE'S TABLE, Showing the Effect on the Power of Hearing of the Removal of an Accumulation of Cerumen in One Hundred Cases; the Normal Distance of Testing-Watch Being Three Feet.

AGE.	HEARING DISTANCE BEFORE REMOVAL.		HEARING DISTANCE AFTER REMOVAL.	
	Right Ear.	*Left Ear.*	*Right Ear.*	*Left Ear.*
22	1 inch	8 inches	18 inches	18 inches
22	normal: no cerumen	half an inch	normal	normal
32	7 inches	crack of nails	12 inches	7 inches
70	contact	contact	contact	contact
33	half an inch	half an inch	normal	normal
35	2 feet	half an inch	normal	normal
45	contact	half an inch	2 inches	2 inches
15	half an inch	3 inches	normal	normal
44	normal: no cerumen	half an inch	normal	normal
59	1 inch: no cerumen	crack of nails	1 inch	crack of nails
25	crack of nails	3 in.: no cerumen	1 inch	3 inches
18	4 inches	half an inch	normal	normal
29	5 inches	normal: no cerumen	normal	normal
8	contact	contact	3 inches	contact
74	half an inch	half an inch	half an inch	half an inch
49	6 inches	6 inches	6 inches	6 inches
53	crack of nails	2 in.: no cerumen	4 inches	2 inches
28	half an inch	normal: no cerumen	normal	normal
26	1 inch	half an inch	8 inches	7 inches
26	half an inch	2 inches	normal	12 inches
49	9 inches	1 inch	9 inches	1 inch
19	7 inches	1 inch	7 inches	24 inches
32	quarter of an inch	half an inch	normal	normal
53	normal	half an inch	normal	normal
30	half an inch	10 inches	6 inches	normal
—	2 inches	$1\frac{1}{2}$ inch	2 inches	half an inch
41	18 inches	5 inches	18 inches	8 inches
65	contact	contact	2 inches	2 inches
27	pressure	pressure	half an inch	3 inches
44	4 inches	pressure	6 inches	3 inches
25	24 inches	1 inch	normal	3 inches
40	pressure	normal	normal	normal
65	crack of nails	crack of nails	2 inches	contact
27	12 inches	contact	normal	normal
27	18 in.: no cerumen	pressure	18 inches	18 inches
70	pressure	pressure	1 inch	1 inch
56	normal	pressure	normal	7 inches
—	2 inches	2 feet	normal	normal
20	2 inches	2 in.: no cerumen	2 inches	2 inches
53	24 in.: no cerumen	contact	24 inches	12 inches
38	contact	half an inch	normal	normal
7	2 inches	normal: no cerumen	24 inches	normal
14	2 inches	5 inches	24 inches	24 inches
29	2 inches	6 inches	normal	12 inches
40	4 inches	pressure	8 inches	5 inches
14	contact	normal: no cerumen	6 inches	normal
35	7 inches	half an inch	normal	normal
22	2 inches	contact	24 inches	normal

AGE.	HEARING DISTANCE BEFORE REMOVAL.		HEARING DISTANCE AFTER REMOVAL.	
	Right Ear.	*Left Ear.*	*Right Ear.*	*Left Ear.*
45	16 inches	3 inches	24 inches	8 inches
19	normal: no cerumen	contact	normal	normal
28	normal: no cerumen	pressure	normal	normal
—	normal: no cerumen	half an inch	normal	normal
46	quarter of an inch	pressure	half an inch	half an inch
23	4 inches	5 inches	normal	normal
44	pressure	pressure	normal	normal
25	normal: no cerumen	1 inch	normal	normal
14	2 inches	2 inches	normal	normal
60	1 inch	1 inch	9 inches	9 inches
27	normal	half an inch	normal	half an inch
50	18 inches	pressure	18 inches	24 inches
20	2 inches	4 inches	normal	normal
11	2 inches	half an inch	8 inches	8 inches
50	2 inches	normal	normal	normal
45	half an inch	half an inch	1 inch	1 inch
5	crack of nails: no cerumen	2 inches	crack of nails	4 inches
35	10 inches	2 inches	normal	normal
28	1 inch	24 inches	24 inches	24 inches
41	normal: no cerumen	contact	normal	24 inches
14	12 in.: no cerumen	2 inches	12 inches	24 inches
24	pressure	pressure	normal	2 inches
60	1 inch	contact	1 inch	contact
34	normal: no cerumen	24 inches	normal	normal
19	2 inches	1 inch	24 inches	24 inches
61	2 inches	2 inches	3 inches	3 inches
65	crack of nails	crack of nails	crack of nails	crack of nails
24	contact	2 inches	normal	normal
40	normal: no cerumen	contact	normal	8 inches
60	contact	crack of nails	contact	crack of nails
56	quite deaf: no ceru.	contact	quite deaf	6 inches
21	normal: no cerumen	6 inches	normal	normal
40	6 in.: no cerumen	4 inches	6 inches	12 inches
51	normal: no cerumen	contact	normal	3 inches
50	6 inches	6 inches	normal	normal
55	crack of nails	contact: no cerumen	contact	contact
41	12 in: no cerumen	contact	12 inches	5 inches
27	normal: no cerumen	half an inch	normal	4 inches
50	normal: no cerumen	contact	normal	1 inch
46	2 inches	half an inch	24 inches	6 inches
35	normal: no cerumen	pressure	normal	12 inches
45	3 inches	3 inches	3 inches	3 inches
74	crack of nails	2 inches	3 inches	6 inches
49	half an inch	half an inch	4 inches	4 inches
57	half an inch	2 inches	1 inch	3 inches
36	crack of nails	crack of nails	1 inch	1 inch
39	pressure	crack of nails	normal	normal
39	4 inches	contact	normal	14 inches
25	2 inches	normal: no cerumen	normal	normal
52	8 inches	1 inch	8 inches	2 inches
54	normal: no cerumen	contact	normal	6 inches
11	contact	contact	12 inches	12 inches

An analysis of the foregoing 100 cases shows the following to be the result of the examination of the 200 ears:—

Ears restored to a normal condition, ...	60
Ears in which the hearing power was greatly improved, . .	43
Ears in which the hearing power was only slightly improved,	35
Ears in which the hearing power was the same *after* as *before* the removal of the cerumen, ...	27
Ears in which there was no wax, and in which the hearing power was normal, the opposite ear being affected, .	24
Ears in which there was no wax; but in which the hearing power was not perfect, the opposite ear being affected,	11
	200

It thus appears that of the 165 ears from which cerumen was removed, only 60 were cured; that, including the 43 cases which were much improved, there were 103 cases of great amelioration, while there were 62 ears that were either but slightly or not at all improved. Thus, out of the 165 ears from which a collection of cerumen was removed, there were 105 in which there was some other disease, the restoration of the hearing not being perfect. The presence of cerumen in the external meatus may be symptomatic of several affections, as obstruction of the Eustachian tubes, or thickened condition of the tympanic mucous membrane, debility of the auditory nerve, anchylosis of the stapes, &c.; it is therefore important that every case should be carefully examined after a collection of this kind has been removed; because, if the hearing power be not wholly restored, some other disease is present which requires attention.

Causes.—The causes producing accumulation of cerumen *in cases not complicated with other diseases*, are,—a narrow calibre of the meatus; the application of cold; the admixture of dust with the cerumen; and, not unfrequently, the practice of pushing into the ear the point of a towel or an aurilave, whereby the cerumen is pressed into a mass towards the membrana tympani.

Symptoms.—The symptoms of an accumulation of cerumen are: sudden deafness, often following a cold by which the dermis is tumefied; bathing or the introduction of water into the ear. This deafness is often better in the morning; is increased by the movements of the jaw during mastication; and often disappears as suddenly as it came, with a cracking sound in the ear. The cause of the sudden appearance and disappearance of the deafness is the movement of the mass of cerumen: when it is so placed as to allow sonorous vibrations to pass between it and the wall of the meatus, the hearing returns; but when it again comes in contact with the meatus, the deafness recurs. Oftentimes a feeling of fullness in the ear is complained of; not unfrequently there is singing and giddiness, and sometimes considerable pain.

Of fourteen hundred and forty-eight aural cases observed by Dr. Roosa, only one hundred and one were what might fairly be said to be cases of inspissated cerumen, or that in which the impaction of ear-wax was the chief cause of the aural symptoms. Collections of ear-wax may remain in the ear for many years. When the mass is very hard, it is liable to cause inflammation of the dermoid meatus.

Diagnosis.—We can only be certain, in our diagnosis of this affection, after an examination of the ear with a speculum and reflector, and a good light. Until such examination has been made no treatment should be adopted.

Treatment.—The only proper method of removing collections of wax from the ear is by the gentle use of the syringe and warm water. As these accumulations in most instances have existed for some time, their removal, owing to the resistance of the mass, is not always readily accomplished. In most cases, however, a skillful use of the syringe with warm water will succeed, in a few minutes, in bringing away the accumulations. In some cases we find that syringing, owing to the hardness of the mass, will not succeed. Some solvent must then be applied. Dr. Roosa prefers a saturated solution of bicarbonate of soda for this purpose. I have for some time been in the habit of adding a teaspoonful of bicarbonate of soda to the warm water used in syringing out these accumulations, and am of the opinion it is of much practical utility as a solvent of these masses. When I find the mass unyielding after a fair trial with the syringe, I usually use a probe or Grass' ear-hook to break the hard surface, after which I usually find the syringe will readily accomplish the work. No instrument should be used in removing or loosening these hardened masses, except under a good illumination by means of the mirror and forehead band. It is always safest to take time to use some solvent as glycerine or bicarbonate of soda. I prefer the former when sufficient time can be given it to act. I prefer to have it applied in the evening and syringe the ear the following day. The glycerine should be lukewarm when applied. The patient should rest his head upon a table or stand while the application is made, and the solvent, whether glycerine or bicarbonate of soda, should be allowed to remain in the ear ten or fifteen minutes. The auditory canal will sometimes be found to contain very large quantities of hardened cerumen, and the ear should be carefully examined quite often during the syringing process, lest the operation be continued after the wax is removed and harm be done to the drum-head. If after the removal of these accumulations the hearing is found to be defective and the drum-head is found sunken inward, Politzer's method of inflating the middle ear should be employed to replace the membrane to a normal position and restore the hearing. Unpleasant symptoms sometimes continue, owing to small flakes remaining on the drum-head; these may readily be detected by means of the speculum and reflector. They should be removed with the syringe and warm water only.

FOREIGN BODIES IN THE EAR.

Foreign bodies in the auditory meatus are generally put there by children at play, and may be anything of a size small enough their busy little hands can place there. Their presence there need not necessarily cause alarm and should not precipitate hasty action in their removal, as they can not be productive of immediate harm otherwise than by the meddlesome interference of nurses or friends and unwise practitioners. The danger is most likely in the unskillful attempts at their removal, which to accomplish readily and successfully is not always an easy task, and very considerable injury is often done by injudicious efforts which are made to extract them. Before undertaking to remove a foreign body from the ear, its presence should be demonstrated by sight. Children are often brought to me to have various things taken out of their ears, when on examination I find there is nothing in them at all. When a foreign body is detected there it should be removed, but great care should at all times be exercised so as not to press such body in against the membrana tympani or drum-head, thereby causing much pain to the patient and great danger of injuring the hearing permanently. Sometimes a foreign body will give rise to a fit of coughing, which is stated to depend on reflex action due to irritation of the auricular branch of the pneumogastric nerve. This appears to be the correct explanation of a symptom which has been spoken of as ear-cough, and has been noticed in cases where a foreign body or some other source of irritation has been present in the meatus.

Cases are on record where a distressing cough has persisted for years and defied all treatment, until by some happy circumstance attention has been called to the ear, the foreign body removed, and the symptom of cough has disappeared.

Various means have been suggested for the removal of foreign bodies in the auditory canal, but *best* and *safest* of all, we may say, is the syringe and warm water. Almost any patient, whether child or adult, will readily submit to the operation of syringing. "I believe," says Hinton in his work on "Aural Surgery," "it may be laid down as a rule that whenever an instrument will succeed, syringing would succeed, and that when proper syringing will not succeed, all instruments are full of danger."

*"I have seen a great many instruments devised to remove foreign bodies. I have read a great many pages devoted to the consideration of the subject; I have heard a good many opinions as to the superiority of this or that method of removal; my belief is, from several years' experience, that syringing is *the* one safe and certain method of removing foreign bodies from the ear. This is *the rule;* there may be some few and rare exceptions. I have, by careful, repeated, well-directed syringing, removed foreign bodies of all descriptions and shapes from the meatus by syringing alone. Only on a few occasions have I ever succeeded in removing a foreign body after failure by syringing, and I feel confident that, had I the opportunity of giving to the syringe a fair trial, I would have found it equally successful. Let me enumerate some of the substances I have thus removed: glass beads of all shapes, shells, stones, pieces of chalk, berries, grains of corn, pieces of slate pencil, &c. I could fill pages with the history of cases of foreign bodies

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* Jones' Aural Surgery, page 106.

in which by syringing alone I have got rid of the troublesome inmate of the meatus. Lately, after frequent efforts had been made with the syringe for some weeks, I got away with a double loop of silver wire and a Wilde's snare, a conical glass bead, which was fixed in the meatus of a child sent a long distance to me. But if my experience of the syringe in such cases is satisfactory, my opinion of the mischief often unwittingly inflicted with extracting instruments is equally strong. I have seen children and adults in which the membrane and ossicles have been pulled and torn in mistake for a foreign body. Frequently have I seen considerable inflammation excited by such attempts. I am not afraid to wait. I recently had a case in which after the lapse of a month a foreign body, a stone, came away, which receded each time I attempted to touch it, and the only mischief was a slight catarrhal discharge. In conclusion, on this much debated question of the extraction of foreign bodies from the ear, I venture to give it as my opinion, that *all* instruments are in a degree dangerous, to be employed with caution, and on no account should their use be continued until proper syringing has first been given a long trial. To syringe the ear, the lobe should be held well back, the head sideways, the face slightly up, and the stream directed with sufficient force so as to pass between the foreign body and the wall of the meatus. I fill the ear with glycerine after each syringing, and repeat the process daily. I have known a piece of cobbler's wax used with success to draw a foreign body out. Glue applied with a camel's-hair pencil (Lowenburg) and allowed to harden on the body has been employed. Dentist's cement may be tried with the same object. Quietness and firmness with friends, patience in using the syringe, extreme caution with all forms of mechanical helps, are the essentials for dealing successfully with foreign bodies in the ear."

Foreign bodies may sometimes remain in the ear a very long time without causing serious harm to the organ or discomfort to the patient. A gentleman a few months ago came to my office complaining of deafness in his right ear with a feeling of fullness and discomfort. On examination with the speculum and mirror I detected some foreign substance in the lower part of the canal imbedded in cerumen, which I removed with a syringe, and found it to be a cherry stone, which the patient, (whose veracity I would not question), insisted had been placed there in his childhood, over thirty years from date of removal, yet the hearing in this case, after the removal of this foreign body, was found unimpaired.

Dr. Burnett of Philadelphia relates having removed, from the the ear of a lady patient of his, a blue glass bead, which had been in the ear over fifty years.

INSECTS IN THE EAR.

When an insect flies or crawls into the ear passage it gives rise to most unpleasant sensations, and when it comes in contact with the membrana tympani the pain produced is usually agonizing in the extreme.

One day, some years ago, a strong healthy-looking man, (butcher by occupation), entered my office, holding his head and manifesting the most excruciating suffering, saying as he entered, "Doctor, there is a bug just crawled into my ear, don't you hear the noise it makes? It sounds like a discharge of musketry by the side of my head. Take it out quickly or it will kill me, I can't endure the pain." I asked him to be seated, and inclining his head to one side and, as the case, seemingly at least, was a desperate one, demanding immediate action, I did not take time to obtain warm water and syringe, but at once filled his ear with olive oil, which I happened to have at hand, when immediately the insect (a large beetle) "backed out." The relief was instantaneous and complete.

Mr. M—, a druggist, at Weeping Water, Nebraska, informs me "a black hard-shelled bug" got into his ear and caused great pain, and was not removed until one year and a-half after, leaving the ear in a diseased state, and much affecting his hearing. The bug, though dead when removed, was well preserved.

A little boy was recently brought to my office by his father, who manifested very great alarm, stating that a fly had got into his son's ear, which was bleeding, and that he was unable to get it out. On examination with the speculum I found his ear had been tampered with to such an extent as to have produced several abrasions, causing the ear to bleed, though fortunately not seriously injuring the drum-membrane. A syringe and warm water readily removed the cause of all this trouble. I may add, to show the anxiety of parents who become unnecessarily alarmed at such trifles, that this poor man brought his boy a distance of ten miles to have a dead fly removed from his ear, for it was dead already when I examined the ear. Nor is this to be wondered at, after having been assailed by the family and after them "by three doctors," who while they did not succeed in bringing it from its hiding-place, were quite successful in killing the "krater."

When an insect enters the auditory canal, the ear should at once be filled with water; this will effectually prevent it from doing harm by either drowning it or forcing it out of the ear. If this does not remove it, the syringe and warm water skillfully applied will readily accomplish all that is necessary.

LIVING LARVÆ IN THE EAR.

*"Insects sometimes deposit their eggs upon the pus of a suppurating ear. According to Wood, who is quoted by Blake,† insects have a very acute sense of smell. 'No flock of vultures can be directed more unerringly to their revolting prey by scenting its odors from afar.'

The odor of an otitis media purulenta thus brings the insect to deposit its eggs in the auditory canal and cavity of the tympanum, where they soon become grubs or larvæ.

These larvæ always excite considerable, and sometimes very severe pain, but in the cases which I have seen, the patients complain much more of the wriggling movements of the grubs in the ear, than of the pain.

The ancient works on aural diseases speak very much of worms in the ear and of the proper means of removing them. It is probable that these so-called worms were the larvæ of insects which germinated from eggs deposited in the pus of a chronic suppurative process. Certain it is, that since the habit of cleansing an ear from pus has become a well-recognized duty, the practitioner of the present time sees very little of worms in the ears.

The pain from the presence of these grubs, which actually fasten themselves, when hatched, into the tissue of the canal, and bite upon it, as it were, is apt to occur suddenly.

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*St. John Roosa's Treatise on the Ear, page 164.

†Living Larvæ in the Human Ear. Archives of Opthalmology and Otology, Vol. II., No. 2.

An Austrian physician, *Dr. Scheibenzuber*,* reports a case of a peasant ploughing in the field, who was seized in an instant, with a severe pain in the ear, which he ascribed to the flying in of a bug, but the surgeon found the ear full of well developed larvæ.

I have several times observed dead insects in the pus that was washed out from an external auditory canal, and it is undoubtedly true, as I have already suggested, that we should, equally with the ancients, have many cases of living larvæ in the ear, were it not that suppurating ears are usually now-a-days regularly cleansed.

The larvæ that have thus far been found in the ear are those of the muscida sarcophaga (*Blake*, *Gruber*), and of the muscida lucilia (*Blake*).

Dr. Blake † has made a study of the nature and habits of these grubs, by taking them from the ear at a very early period of development; as near as could be ascertained within twelve hours of the time of their deposit. He placed a specimen on the bottom of a thin glass vessel and covered it with a piece of raw beef, soaked in warm water, in such a manner that by inverting the glass the movements of the larvæ could be easily studied under the microscope.

Dr. Blake found that the apparatus by which the larva attaches itself, and which pierces and tears the tissue, is made up of a strong but delicate framework of horny consistency and of two hooks also of a stout horny structure, articulating with this framework. The larva burrows its way into the tissue on which it feeds by repeated extension and contraction of the hooks, alternately piercing and tearing.

These movements explain the agonizing pain which patients experience when the larvæ appear from the eggs.

These hooks are very large in proportion to the size of the body of the larvæ.

Dr. Blake says that the instincts of the animal lead it to bury itself beneath the surface, and to seek warmth and moisture and a soft, yielding tissue for its work. Hence, they are always found at the end of the canal or in the cavity of the tympanum.

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* Monatsschrift fur Ohrenheilkunde, Jahrgang III., No. 3.

† Archives of Opthalmology and Otology, l. c.

As yet, they have always been found in connection with suppuration of the middle ear, with its consequent perforation of the membrana tympani.

The examination of the auditory canal infested by living larvæ, shows small white worm-like animals moving rapidly about, very much as a mass of common earth-worms. As I write, I have before me a number of specimens of the dead grubs. They are about half an inch in length, and of the diameter of a large knitting needle.

Treatment.—I have found it impossible to remove living larvæ by means of the syringe. The more they are syringed the more lively they become. Before the syringing is attempted, some agent should be instilled into the ear which will kill them, when the syringe will usually remove them. Sometimes, however, even after death, their hooks penetrate so deeply into the tissue that they can only be removed with the forceps. The forceps should not be needlessly used, however, for even with the most careful manipulation, and with tractable patients, they often abrade the integument of the canal, and thus cause pain. I have used Labarraque's solution of chlorinated soda to kill these grubs, but simply because it was at hand when I saw the cases.

The larvæ have also been killed by forcing the vapor of chloroform into the cavity of the tympanum through the Eustachian tube. I believe, however, that it will be sufficient to force the vapor into the external ear, or to instill some such fluid as I have mentioned into the canal.

It need hardly be said, that the disease which allowed of the deposition of the eggs, and the hatching of the grubs, should be treated after they have been removed. Even those who are advocates of allowing a discharge from the ear to remain unchecked, will hardly defend such a neglect when the ear has become a disgusting receptacle in which larvæ are formed."

PART VII.

DISEASES OF THE MIDDLE EAR.

DISEASES OF THE MIDDLE EAR.

INJURIES OF THE DRUM-MEMBRANE.

Injuries to the membrana tympani happen either from direct application of violence, from blows to the head, or from explosions. Direct injury arises, not unfrequently, from something introduced by the patient into the ear—most frequently hair-pins. The most dangerous results, however, ensue when a needle or other sharp body is introduced by another person. I have recently had two such cases, one a little boy aet. five years, who, while at school, had a crochet-needle thrust into his ear by one of his little class-mates, penetrating the drum-membrane, causing the blood to flow freely. The other a young lady, while picking her ear with the end of a knitting-needle, had the same driven into the membrane by her sister suddenly striking her hand.

Both cases recovered perfectly, there being but little impairment of hearing in either case. There was some constitutional disturbance in the case of the former, which lasted a few days followed by discharges, all of which yielded readily to good nursing and careful treatment. Dr. Hinton says: "Death has resulted in the course of a few days from a crochet-needle entering the meatus on a sharp turn of the head."

Severe blows or falls upon the head may rupture this membrane. I was one time called to see a man who was supposed to be dying of a hemorrhage from his ear. I found the patient (a laboring man aet. 50 years) unconscious. On inquiry as to how he came to this state was told that he had a fall backwards from the stairs after having ascended two or three steps on his way to bed. On examination I found an extensive fracture of the base of the skull with rupture of the membrana tympani. The hemorrhage amounted probably to a pint or more. The patient was removed to the hospital the following morning before I got to see him, but had died on the way.

Explosions are a frequent cause of rupture of the drum-membrane, and nearly always destroying it and seriously injuring the hearing permanently. I have just examined a case of this kind in which both drum-heads were entirely destroyed, and also the hearing, by an explosion of a shell during an engagement in the army. This patient states he had been insensible for some time after the occurrence, and that twelve others were killed or wounded from the same explosion. Boxing the ear is another cause of this accident. Hinton says, "But probably no more cruel injustice is done than that which is inflicted in boxing children's ears for inattention. Children are not inattentive, but distinctly curious and alert, and a child who incurs boxes on the ears on such ground is probably doubly injured, in mind as well as body, by the injustice as well as the hurthfulness of the blow. I have known a youth die of brain disease from inflammation of the ear, whose history was that when young his father used often to box his ears for not attending." Violently blowing the nose may cause rupture of this membrane. This mostly occurs in cases in which its structure has been previously weakened. One such case recently came under my observation. The right ear had been diseased for some time from chronic aural catarrh, and the left ear was some affected, when one day the patient called on me saying that on violently blowing his nose he felt a queer sensation in the ear, and that immediately his hearing became much impaired. On examination I found the membrana tympani badly lacerated. Violent vomiting also has caused rupture of this membrane.

Perforation of the membrane sometimes occurs as the result of inflammation of the meatus, though much more rarely than from inflammation within the tympanum.

If an incision be made with a sharp knife purposely by the surgeon the wound quickly closes up, sometimes in two or three days.

*"In all the cases I have seen, when the tympanic membrane has been accidentally ruptured, the extent of impairment which the hearing has suffered is in a very great measure proportionate

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* Dalby on Diseases and Injuries of the Ear, page 142.

to the degree of violence used. Obviously, more violence will be required to rupture the tympanic membrane when the force is applied from without, if the instrument causing such a rupture is a blunt-pointed one, than when it is sharply pointed or edged; and, in any case, if the force is applied from within, as in vomiting or blowing the nose vigorously, or, again, in the example of a blow on the head, or a box on the ear, the force employed must be considerable.

If the impaired hearing in these cases depended solely upon the rupture of the membrane, when healing takes place in a few days afterwards without any inflammation in the tympanum, one would expect very naturally that good hearing would succeed to the continuity of the membrane, but experience shows that it is not so. The true cause of the permanent deafness is, I believe, dependent upon the shock which the nervous structures (the labyrinth) have received at the time of the accident, and this view is rendered extremely probable when we notice that a similar extent of impaired hearing will follow the same kind of accident (a blow on the head or a box on the ear) when the tympanic membrane has not suffered at all.

The fact of the membrane being able to withstand shocks, such as a violent explosion or a box on the ear, when either were expected, was explained by Mr. Toynbee as being due to contraction of the tensor tympani."

Treatment.—The treatment required for accidents of this kind, is in most cases, to leave them alone, and prevent the hurtful meddling of anxious friends, who advise all sorts of things to be poured into the the meatus, and generally with the result of exciting inflammation of the tympanum. Quietness should be enjoined, and the patient should remain indoors until all inflammation has subsided. If there is any bleeding, the ear should be syringed with great gentleness; and if the pain following the accident does not shortly subside, three or four leeches may be placed in front of the tragus, and followed by fomentations. Should the wound not heal, and a discharge be established, the case will require the same management as a perforation after disease.

FRACTURE OF THE HANDLE OF THE MALLEUS.

This is a very rare accident, and one I have never been called upon to treat or witness. Several cases have been described by Meniére, Von Tröltsch, Wier and Hyrtl.

Causes.—The causes reported to have produced this fracture are direct violence, such as a thrust of a pen-handle into the ear, and heavy falls. None of the cases reported were seen in the early stages or soon after the fracture had occurred, and no treatment had been adopted in either case. The fractures had united in two of these instances, one in that of a prairie dog reported by Hyrtl.

AURAL CATARRH.

This being the most frequent of all affections of the ear, and the commonest cause of deafness, in all periods of life, whether young, middle aged or old, the subject will, therefore, not fail to receive our special attention. It may be well here to refer the reader to the anatomy of the parts involved in this affection, and to the subject of the examination and mode of investigating by mechanical appliances, and diagnosing the ailments of the middle ear and Eustachian tube. Authors have written upon diseases of the tympanum under various appellations, naming them according to their anatomical and pathological relations, but such divisions of the subject appear to be very unsatisfactory, inasmuch as the mucous membrane lining the Eustachian tube and mastoid cells is contiguous, it is perfectly useless to attempt to separate in description the catarrhal diseases of the Eustachian tube and mastoid cells from those of the tympanic cavity itself; because all the affections now under notice have their origin in the mucous layer of some of the parts of the middle ear just mentioned, and it is evidently impossible to limit inflammatory action, whether acute, sub-acute or chronic, to the particular structure in which it originally commenced, but will assuredly sooner or later extend over the whole mucous layer of the tympanic cavity, and thus become common to all.

ACUTE AURAL CATARRH.

*"ACUTE CATARRHAL INFLAMMATION OF THE TYMPANUM may consist in mere hyperæmic swelling of the mucous membrane, with slightly increased secretion of mucus; or it may extend into a most dangerous and even fatal disease.

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* Allen, on Aural Catarrh and Curable Deafness, page 101.

The first form is sometimes very transient, passing off in a few days, without leaving any impairment of function behind. The *causes* of such a mild and temporary deafness are usually supposed to be 'catching cold,' getting the body or feet wet, influenza, or the like. The *symptoms* are described by the patient as 'having a cold in the head,' stuffing of the nostrils, heaviness over the brow, sore-throat, singing or tinnitus in the ears. The slight impairment of hearing which accompanies these symptoms is occasionally relieved by blowing the nose, coughing, sneezing, &c. The parts involved belonging to the ear are, the Eustachian tube, especially in its faucial portion, and the whole cavitas tympani; and we also generally observe that such conditions of these parts as are above described are associated with congestions or catarrhal inflammation (as they are termed) of the nasal passages, fauces, bronchial tubes, and sometimes of the lungs.

This mild, though acute and sudden, catarrhal affection (which might more properly be named *congestion*) produces seldom any decided alteration in the appearance of the membrana tympani or of the auditory canal. Occasionally there may be a somewhat reddish tinge mingled with the grey colour of the membrane, resulting from the injection of the mucous layer within; and sometimes the transparency of the membrana tympani permits the congested interior layers of mucous tissue, with a large amount of accumulated secretion, to be distinctly seen.

In this latter form, which may be considered as the *second* degree, or a state between simple congestion and progressive inflammation, hearing is impaired, singing in the ears becomes annoying, a sensation of fullness is experienced, and when the drum is inflated by the Politzer method or catheter, the moist gurgling sound indicative of the presence of fluid within the cavity of the tympanum, is plainly heard through the otoscope or by the surgeon's practised ear without the assistance of that instrument.

In the *third* degree, when the inflammation is higher, the symptoms are more general. The throat participates in the attack; its mucous membrane is tumid, thickened, and severely injected, and swallowing is often painful and difficult. The acts of coughing, sneezing, or blowing the nose increase the pain by the sudden and forcible expulsion of air through the constricted and inflamed Eustachian tube. Cracking sounds and a feeling of bursting are complained of in the ears, or the drum cannot be inflated at all, owing to the complete closure of the tube. The patient's own voice is described as 'reverberating,' or 'hollow.' The tuning-fork placed on the vertex of the head, will, in consequence of its vibrations conveyed through the cranial bones, being prevented from easily escaping out of the auditory meatus, be more distinctly and longer heard by the patient than by the surgeon. I have frequently tested the power of hearing sounds thus transmitted in those suffering from catarrhal inflammation of the middle ear; and when, as compared with my own, the perception of them is enhanced, or the same as mine, there is tolerable certainty that the important fenestral openings in the labyrinth-walls have as yet escaped any considerable implication. It may also be inferred that the portion of the tympanic mucous membrane which lines the internal walls of the cavity is neither rigid nor much thickened; for when it is severely affected by these catarrhal processes, I have almost invariably found that fixity of the base of the stapes in the fenestra ovalis, as well as more or less impairment of vibratility in the membrane of the fenestra rotunda cochleæ, is the result. The tumefied and thickened mucous membrane binds down these elastic oscillating structures, and disables them from influencing by their rapid wave-like movements the fluid contents of the vestibule and cochleæ, in which the filaments of the auditory nerve are, as you recollect, suspended. So that, when there is little or no perception of sound through the cranial bones, and from the history of the case and other general symptoms there is no reason to suppose that the auditory nerve itself is diseased, the deafness in catarrh may be attributed to excessive pressure upon the fenestræ, and consequently upon the contents of the labyrinth, by hyperæmic, unyielding mucous membrane. Rigidity of the whole ossicular chain, and exudation of lymph in the tympanic cavity, will likewise obviously cause the mobility of the stapes in the fenestra, and the vibratile power of the membrane of the fenestra rotunda, to become impaired; and in addition to these serious hindrances to hearing, the membrana tympani may have become so swollen and thickened by organized deposits, hæmorrhagic exudations, &c., upon its inner mucous layer, that the cavity of the tympanum is reduced in size. This condition superadded, will assist in wholly stopping the vibration of the auditory ossicles, but would not of itself, I think, prevent the tuning-fork from being heard through the bones of the head, if the mucous membrane at the inner wall of the drum abutting upon the labyrinth were not implicated in the disease.

I have been thus particular in drawing attention to the use of the tuning-fork as a modern and an additional means of distinguishing catarrhal disease, occurring in the cavity of the tympanum, and causing, by intra-auricular pressure, impairment of function, from those ailments in which the nervous apparatus is primarily affected, because you might with much reason inquire during the examination of a patient by whom the tuning-fork is not heard when placed on his forehead, 'Why may we not consider the case as one of *nervous* affection, originally and chiefly?' In my third lecture it was remarked that there is a limit to this mode of investigating, and now you have evidence that the objective symptom must never be viewed alone, but in connexion with others, and also especially with the history, cause, and duration of the disease. By practice, and attentively observing and analysing the cases brought before you, I am sure you will not find it difficult to arrive at correct conclusions on this most important point. I need not tell you how essentially necessary it is that you should be able to inform your patient whether the severe deafness depends upon a morbid condition of the drum cavity (which in simple acute catarrh is generally transient though urgent), or that you are compelled to infer from this objective mode of examination the infirmity to be 'nervous,' in which case recovery is not to be expected.

I may here digress for a moment, and observe that it is somewhat consolatory to deaf persons, and may induce them more readily and earlier to apply for professional assistance, if they learn that with the increase of our knowledge of such morbid processes as take place in the middle ear (that is, externally to where the nerve is expanded), and the improvement in examining and distinguishing its various affections, the number of (so called) 'nervous' cases has wonderfully diminished. Those which were formerly regarded as incurable, because their pathological conditions were not recognised, and therefore could not be removed by treatment, are now, by the progress of scientific aural surgery, brought under some degree of control; and both in objective modes of investigating nervous complaints, and in treating the diseases of other parts of the ear, mistakes are less frequent than formerly, and cures more numerous.

ACUTE CATARRHAL INFLAMMATION OF THE MEMBRANA TYMPANI.—The membrana tympani is seldom affected alone, but generally by extension from the mucous membrane lining the cavity. The acute form of this ailment is more uncommon than the chronic, but requires energetic treatment to prevent it from lapsing into the latter. Many persons can trace their difficulty of hearing to acute attacks of catarrhal inflammation in early life, when they were considered to have merely an 'ear-ache' from cold, 'not of much consequence,' or they may have suffered repeated catarrhs of the ear, and recovered their hearing without any special local treatment. We now, however, know that when patients have once been the subjects of aural catarrh, they are predisposed to the return of deafness, which in course of time becomes not only severe, but permanent. The cause of this recurrence of deafness is easily made clear, both from anatomical and pathological considerations. I have already stated that in *tympanic* catarrh a swelling and thickening of the mucous membrane occurs, causing adhesions and connexions between parts which should be free to vibrate; and it will be observed that such attachments most frequently occur between the membrana tympani and promontory, between the same and the ossicles, and between the ossicles (the stapes very generally) and fenestra ovalis. When the cavity of the drum is thus diminished in size by hyperæmia, by thickened lining membrane, adhesions, and abnormal connexions, it is very evident that any slight additional swelling or congestion, such as results from a 'cold in the head,' or the sudden application of cold externally to the membrana tympani, by draughts of winter air, &c., will almost obliterate the already narrowed space of the drum-cavity, and most sensibly impair the hearing. In an analogous condition of the eye, where the iris becomes adherent to the capsule of the lens (constituting senechia posterior), proper vision is hindered in consequence of irregularity in the muscular action which is necessary in accommodating the eye for sight at varying distances. In the same way, the two muscles of the ossicles (the tensor tympani and the stapedius), which undoubtedly regulate their movements, and accommodate the ear to receive sounds of all characters and degrees of intensity, will, when confined and limited in their action by adhesive bands, the result of catarrhal inflammation, render the motions of the membranes of the tympanum and the labyrinth irregular, uncertain, and inharmonious. It follows that even if the deafness be not severe, the power of hearing ordinary conversation or several sounds at one time is much diminished, and many patients thus affected can only hear when they listen attentively to the person talking. This symptom is not unimportant, since it indicates very plainly the seat of the mischief. The physiological explanation of the inability to distinguish the various intonations of the human voice when the action of the tympanic muscles, especially the stapedius, is impeded by the thickened mucous membrane of the drum-cavity. Whenever, then, you see a patient dull of hearing, vacant in look, and only when he listens attentively, capable of entering into conversation and distinguishing what is said (that is, only when he exercises the stapedius muscle by an effort of the will), it may confidently be assumed that the accommodating power of the ear is defective or lost in consequence of congestion and thickening of the lining membrane, plastic exudations or adhesions in the cavity of the tympanum.

The description of these symptoms and states of the middle ear, and of their liability to recurrence, will impress on your minds the necessity of preventing by timely treatment, their becoming the source of permanent deafness. If patients are unwilling to submit to remedial measures, expostulate with them, and explain the probable consequences of their refusal. They will not 'grow *out* of' their ailment, as medical men are almost daily reported to me to have said, but *into* it.

The *pain*, varying according to the degree of inflammation, and the layers of the membrana tympani affected, may amount merely to uneasiness, intermitted or continuous, or to intense agony. Acute attacks of catarrhal inflammation of the drum and its membrane are more common with children than in the adult. They are apt to occur after exposure to cold, blasts of driving wind and bathing, generally coming on suddenly in the night, and increased by the recumbent position, and pressure of the ear on the pillow, which seem to favour congestion of the membrane. In the adult, the symptoms are more formidable in character; and persons of a rheumatic or gouty diathesis are more prone than others to catarrhal inflammation of the membrana tympani, owing, I believe, to its peculiar texture, in which fibrous membrane forms so large a part. It is not always possible to define the symptoms of an acute catarrh originating in the cavity of the drum and invading by extension the fibrous laminæ of its membrane (well termed by Wilde *myringitis*), but the pain which accompanies them is usually more severe and lancinating than when merely the internal mucous or external cutaneous layers are implicated. It is often compared to a knife running into the brain, is increased by swallowing, coughing, sneezing, blowing the nose, &c., and becomes occasionally so excruciating as to induce delirium. The pulsation of the carotid artery (which lies in such close proximity to the inflamed structures) is not only distinctly heard in the ear, but each throb is felt, adding to the general excitement and suffering. The whole of that side of the head on which the inflammation fixes is acutely painful to touch or motion (even the eye, teeth, temple, &c.); in fact, the severity of the pain experienced is a test of the amount and extent of the inflammatory action; so that if the majority of the above-mentioned symptoms be present, we may conclude the whole cavity of the tympanum, as well as the several layers of the membrane, to be involved. Sometimes fatal consequences ensue from inflammation extending to the brain, but such cases, together with those terminating in suppuration (constituting *purulent aural catarrh*), will be more particularly referred to when that subject comes under notice.

Deafness comes on contemporaneously with the pain, or soon afterwards, but if only one side be attacked the patient will not invariably be sensible of the diminution or loss of his hearing. In rare cases at the commencement, an exaltation of the auditory sense occurs (hyperacusis, analogous to photophobia in opthalmic disease). *Tinnitus aurium* of all kinds is usually coincident with the painful seizure, and the greater the nervous excitement, and higher the degree of inflammation, the worse will be these noises.

To these local symptoms must be added certain well-marked constitutional ones, such as impairment of the functions of the brain, distress, anxiety and depression of mind, giving rise to the worst forebodings, restlessness, sleeplessness, or in the severest cases, delirium, and symptoms of cerebral disease.

APPEARANCES OF THE MEMBRANA TYMPANI AND MEATUS EXTERNUS IN ACUTE CATARRH.—On account of congestion of its mucous layer, and opacity of the fibrous and dermoid layers, the *colour* of the membrana tympani undergoes several modifications. At the commencement of the attack, when the symptoms of acute catarrh or of myringitis are somewhat severe, the external surface has a peculiar glistening appearance, which gives the uniformly reddened membrane a polish like a 'copper plate.' This state does not last long, for the epidermic layer soon becomes infiltrated, and the shining appearance gives place to a dull pinkish hue which may vary to all the shades of red, according to the degree of vascularity, which of course corresponds to the greater or less amount of inflammation, and the component parts of the membrane engaged. Sometimes, as in the coats of the eye, new blood-vessels seem to start into existence, and encircle the membrane with a zone of vivid red, as seen in irritis, or on the borders of the cornea in corneitis.

The arteries running down the malleus-handle are especially marked out at the onset, but afterwards their separate ramifications cannot be distinguished, owing to the increase of vascularity, and the malleus-handle itself will be lost to view in the generally swollen and reddened mass. The auditory canal is not much affected in the earlier stages of the disorder, but later it becomes injected, dry, glistening, and swelled, especially at the part contiguous to the drum-head, so that the usually well-defined boundary between the two is not recognizable. *Ecchymoses*, or irregular hæmorrhagic spots are seen on the surface of the membrane, or within the drum if the membrane remain sufficiently transparent. *Vesicles* are also observed, caused by the separation of certain portions of the epidermoid layer, through effusion of serum, which look like pustules, and although these subside with the acute inflammatory action, we can never accurately decide whether the case is to develop into merely a simple catarrh, or to become aggravated into the purulent form.

ACUTE INFLAMMATION OF THE EUSTACHIAN TUBE.*—It has been proved that the mucous membrane lining the tube is an extension of that of the pharynx, and that it passes into the tympanum and mastoid cells, without any solution of continuity or line of demarcation whatever.

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* For an outline of its anatomy see page 40.

There needs, consequently, no further demonstration to convince you that when a severe affection of the fauces, soft palate, uvula, tonsils, or any portion of the naso-pharyngeal mucous membrane exists, the Eustachian tube must almost inevitably participate in the congestive and hyperæmic condition. Moreover, when we consider the anatomical relations of the tube and mastoid cells to the cavity of the tympanum, we cannot be surprised to find that in these parts, at the further end as it were, of the same system of mucous surfaces, a similar condition will generally co-exist, and the subjective symptoms will be much like in character to those enumerated in the last lecture as belonging to catarrhal inflammation of the tympanic structure itself. In the following description it will be impossible always to avoid repeating details and symptoms common to inflammation of the part last named, because the diseased action, though it may have begun elsewhere, sooner or later extends to the drum and its contents. In this purely mechanical way, therefore, we have a thorough and complete aural catarrh established from simply 'catching cold,' 'getting the feet wet,' 'having a sore throat,' &c., according to the patient's description.

The appearances of the different mucous surfaces in inflammation, will vary according to the particular portion affected—for there are numerous morbid changes taking place—but if rhinoscopy were more practicable than it is while our patient is the subject of acute pharyngeal inflammation, we should be able to describe the pathognomonic evidences with greater precision. If the throat be looked into (and it should always be done) when either the Eustachian tube, the cavity of the tympanum, or its external membrane is in an inflammatory condition, we notice its mucous membrane to be red, tumid, velvety, spongy-looking, and infiltrated; or with even the mildest cases, severe injection of the blood-vessels. The nose and frontal sinuses partake in the unhealthy condition of the adjacent tissues, and a feeling of 'stuffing' in this part is present, together with the characteristic open mouth and faucial, instead of nasal, breathing so commonly observed. In this form the ailment attacks chiefly children and young or middle-aged persons; and the light-haired, fair-complexioned, debilitated, or scrofulous are more liable to it than others. There is a want of power over the muscles of deglutition; swallowing is therefore difficult, and accomplished with pain, which is aggravated by every motion of the throat; for it will be remembered that the muscles concerned in deglutition are also muscles of the Enstachian tube, and that their fibres interlace themselves among the glands and neighbouring mucous surfaces of the soft palate. By reason of their intensely inflamed and painful state, these muscles of the palate and Eustachian tube are rendered incompetent to perform their proper function of drawing apart the walls of the tube each time the patient swallows. The lining membrane of the Eustachian tube being already much congested and thickened, and perhaps secreting mucus too abundantly, the patient experiences a peculiar sensation of fullness and occasional 'bursting' in the drum of the ear, which most of us have been conscious of when suffering from influenza or catarrh.

In such patients the voice sounds hollow, in proportion to the amount of obstruction in their Eustachian tube and tympanum; and this is a symptom peculiarly marked if both ears are affected, or if the unaffected one be closed with the finger. On the abatement of the more severe symptoms (such as fever and pain) already noticed as common to tympanic and tubal inflammation, the dull, heavy, and stuffed feeling in the ear, head, and throat, with deafness, will perhaps remain. Sometimes, however, relief to these sensations is afforded by dislodgement of the mucous secretion from the guttural orifice of the tube, which is accompanied by a loud 'crack,' or report, in the ear. This 'pop' may occur suddenly during sneezing, yawning, blowing the nose, vomiting, or some sudden respiratory effort, and is generally the prelude to improvement or complete restoration of hearing. The amendment, however, may be only temporary, and the hearing may be lost again. This makes it necessary that I should explain to you more in detail how the results of acute catarrh of the Eustachian tube (more especially in reference to its faucial end), may not only damage the patient's hearing at the time, but in spite of *general* treatment occasion future severe or perhaps incurable deafness.

The lower portion of the tube being implicated in almost every 'bad cold,' its closure follows, either in consequence of the thickening of its walls, or from hyper-secretion of mucus within the very small channel which it naturally is. The walls of the tube thus become more or less firmly agglutinated, and *greater muscular action is required to draw them apart.* Now, when these muscles which move the palate in swallowing, and by their contraction pull upon the walls of the tube and open the passage into the (otherwise closed) tympanum, are hindered in their action, air can neither enter nor recede from that cavity. Thus, one of the primary requisites for perfect audition (viz., the equalization of density between the atmospheric air, and that contained within the drum), is absent. No interchange occurring, the air which was in the cavity of the tympanum gradually disappears in the course of a day or two (probably by absorption), or at all events it becomes rarefied or exhausted, being doubtless influenced thereto by the increased heat, and congestive swelling of the mucous membrane lining this occluded chamber. The immediate effect of this unnatural condition is to produce increased concavity (as seen from the outside) of the membrana tympani, a forcing inwards of the chain of ossicles, and undue pressure upon the contents of the labyrinth, causing the hearing powers to be seriously diminished. In addition to this mechanical effect upon the important structures of the internal ear, by the impaired function in the Eustachian tube-muscles, and the consequent impermeability of the tubular passage, you will not be surprised to learn that other abnormal symptoms are soon manifested in the cavity itself, such as have been previously detailed. In severe cases, exudations from the acutely inflamed mucous membrane rapidly follow; viscid, tenacious mucus is abundantly poured out; and this being prevented from escaping through the Eustachian tube (its natural outlet), settles upon the delicate little bones and their muscles, and impedes their vibratility and adjusting action, throwing their mechanism out of order, or at the very least rendering their motion irregular and out of harmony;—because of the disproportion thus developed between the power possessed by and the work demanded of these little 'accommodating muscles' of the ossicular chain. The rarefaction or exhaustion of tympanic air, together with the congestion (however slight) of the lining membrane, which would produce no appreciably injurious effect upon a cavity of normal size, will in one that has been narrowed as just described, lessen the acuteness of hearing in a most sensible degree.

The further results of continued closure of the Eustachian tube, as well as the various forms of adhesions and attachments which are developed from the contact of mucous surfaces within the middle ear, belong more properly to the subject of *chronic* catarrh of the tympanum, and will be hereafter fully noticed, as indeed their importance demands, likewise other morbid conditions causing tubal obstruction, such as *thickening* or *relaxation* of the mucous lining membrane.

Occlusion of the Eustachian tube, with some of the before described consequences, may be observed in some patients to accompany every cold in the head, influenza, or bronchial attack, and if the hyperæmia and tumefaction only last a short time, the middle ear will generally recover its functions as soon as the communication between the throat and drum-cavity is restored. Equilibrium of air being established on each side of the drum-head, this thin yielding membrane will resume its normal position, form, and elasticity. Freed from undue pressure inwards of the membrana tympani, and through it, from pressure of the last bone in the ossicular chain against the tender structures of the labyrinth, the patient will lose the sensation of fullness in the ears, and the distressing noises. In some of the severer cases, particularly in children, it is difficult at the commencement to distinguish an acute attack of aural catarrh, with completely obstructed tube (which of course aggravates the subjective symptoms of tinnitus, giddiness, pain, and excitement amounting sometimes to delirum), from meningitis, or congestion of the brain. More especially may the practitioner imagine the case to be one of cerebral origin, if the deafness, which may have occurred only on one side, have escaped his notice, and the local pain become so extended as to be no longer recognisable as proceeding from the ear. I believe that these formidable, but by no means uncommon, symptoms, are chiefly owing to pressure upon the fenestral openings into the labyrinth consequent on congestive swelling of the tympanic mucous membrane, or a large collection of mucus within the cavity. There is also an anatomical reason why these peculiar attacks of vertigo, and symptoms indicative of meningeal irritation should be so frequently contemporaneous with catarrhal inflammation of the tympanum and mastoid cells, and with the obstruction of the conduit, the Eustachian tube. You will recollect the arterial connexion which exists between the vessels of the dura mater and the cavity of the tympanum, and that consecutive inflammation of the internal ear may have supervened.

It must be once more reiterated that imperviousness of the Eustachian tube, by preventing the escape of mucus from the tympanum into the pharynx, will cause retention and accumulations of morbific deposits; and that these, by keeping up constant irritation, will produce a baneful effect upon the tissues and contents of the middle ear, and will also enormously impair the hearing, by giving rise to adhesions and attachments of the ossicles to each other and to the walls of the cavity, and finally causing changes at the fenestræ of the labyrinth. Consequently experience teaches us that every person who has once suffered from severe catarrh of the ear, will be for some time constantly liable to a recurrence of the attack, and to relapses of deafness, from the presence of such irritating, clogging deposits, and of 'membranous bands,' the products of inflammatory action. In proportion to the number of them remaining after the attack, and the extent of the adhesions limiting the mobility of the ossicles and the vibrating membranes, will be the probability of recurring disease and the degree of deafness. Treatment, therefore, to be successful, must greatly depend upon our ability to prevent permanent thickening of the mucous membranes, and the formation of deposits which favour adhesions between the various parts within the tympanic cavity or Eustachian tube.

Prognosis.—The *prognosis* of acute aural catarrh is, on the whole, favourable when, 1st, it does not run on to suppuration; 2nd, if in the progress of the case, the membrana tympani does not become largely perforated. And 3rd, if it does not eventuate in any of the adhesive processes just enumerated, when secondary changes in the fenestræ or in the labyrinth have also occurred.

A certain proportion of these cases do unfortunately result in some deeper-seated or permanent affection, but these will be referred to hereafter when I come to speak of the *chronic* and *purulent* forms of aural catarrh. The number of these relapses, and bad consequences, would undoubtedly be much lessened were practitioners more generally able to recognise the incipient aural disorder; for it may be asserted with confidence that such affections of mucous membranes are quite as amenable to early treatment, and are as rapidly recovered from as other diseases, when they are energetically and properly attacked by treatment.

Treatment.—The treatment of acute aural catarrh consists, in the first place, in the local abstraction of blood by means of leeches. Seldom will you have occasion to employ venesection or cupping behind the ears, as recommended by some authors. The employment of leeches is not only advisable because it is the most effectual and easiest mode of abstracting blood, but because they can be applied nearest to the seat of disease, and repeated as often as is necessary. From three to six should be made to attach themselves, some just in front of the tragus, and some below the lobe of the auricle. These are the points where they can be applied with the greatest advantage. If the mastoid process be the seat of inflammatory action, and especially if it be tender to the touch, they should likewise be affixed there, close to the angle between it and the auricle. It is sometimes desirable to abstract blood from the orifice of the meatus, particularly when the membrana tympani is actively inflamed; in which case the auditory canal must first be filled with cotton wool, to prevent the blood from falling to the bottom of the passage, coagulating there, and encrusting the surface of the tympanal membrane. From neglect of this precaution, instances have been known of leeches attaching themselves too far inwards, and causing extreme agony. I always mark the places where I wish them applied, with spots of ink, so as to avoid their being scattered about and employed uselessly, if not detrimentally.

The relief afforded by judicious leeching in acute catarrhal inflammation of the membrana tympani is often immediate, and perhaps more marked than in any other painful affection with which I am acquainted. The application may be repeated if the pain should not abate, or should it recur with severity. The bleeding should be encouraged by hot fomentations, stupes, poultices, or spongio-piline soaked in hot water. The moist heat of steaming, poulticing, &c. (with which a variety of sedatives may be combined), will be particularly grateful to the feelings of the patient. The vapour of very hot water medicated with opium, belladonna, conium, henbane, camphor, &c., directed to the fauces, gives comfort; or atomized fluids, composed with the same medicaments, in the form of spray, may be used in all inflammatory affections of the fauces, Eustachian tube, and cavity of the tympanum. Filling the external meatus hourly with water as hot as can be borne, and allowing it to remain for five or ten minutes, is an excellent way of applying both warmth and moisture as near to the seat of mischief as possible. The outer ear and contiguous parts may be unremittingly poulticed with 'spongio-piline' soaked in medicated hot water, or with what is still better and more convenient, the new 'epithema.' This 'ever-ready poultice and fomenting pad' is formed of flat pieces of sponge sewn up in fine linen, and a soft external waterproof covering. It retains the water, whether medicated or otherwise, and keeps it warmer for a longer time and without dripping than any other form of poultice known to me. It is besides very light, and can be fitted over the ears more closely than a linseed meal or bread poultice. Those who have suffered from the complaint now referred to, which becomes agonizing when the external surface of the membrana tympani is involved in the catarrhal inflammation, will testify to the almost magical effect of thorough and careful leeching, supplemented by hot douches and incessant poulticing, in relieving it. Cases of this character have been brought to me after days and days of treatment by blisters, stimulating drops and oils poured into the ear, without the slightest beneficial results, but which the use of a few leeches placed in front of the tragus succeeded in mitigating almost instantaneously. Leeching and hot water applications in some shape or other are therefore *the* local remedies on which you must rely.

I cannot advise you to give emetics or sternutatories at the beginning of these acute cases where exudations and softening of structure rapidly occur, by which the membrana tympani is rendered more liable to rupture. Even the *attempt* to inflate the tympanum is from the actively inflamed state of fauces, palatine arches, tonsils, &c., an effort producing pain; but an accomplished inflation (if the Eustachian tube has not already become entirely closed), is more acutely painful. Any agents, therefore, which cause sneezing or vomiting, are, though given with a view of getting rid of the too abundant mucous secretion or engorgement, inappropriate, because of a risk of perforation in the drum-head, which is (speaking comparatively) a rare consequence of the ailment we are now treating of. When there is much febrile disturbance accompanying the acute stage of this aural disease, mild aperients and diaphoretics are clearly indicated. They may be administered with morphia, hyoscyamus, conium, or any of the sedatives and narcotics which are the most suitable to and best borne by the patient—for the purpose of inducing sleep and lulling pain. Hydrate of chloral will perhaps, from its tranquilizing hypnotic powers, supersede in a great measure the use of opium, being free from several of the deleterious properties of the latter.

It is usually recommended by authors, to have recourse 'at once' to the use of mercury in one form or other (generally as calomel, with opium), and this, not only if the pain and deafness remain unrelieved, but even if the redness and vascularity of the external tympanal membrane are persistent. Inasmuch as within the last few years most of the acute opthalmic and other disorders are treated successfully without the free use of calomel, or mercury in any form, and as the affection of the ear now under consideration may be compared (not inaptly) with those of analogous parts in the eye, we should endeavor to treat aural diseases in like manner, and on like principles. I am confident that you will not be disappointed in arriving at equally successful results by abstaining from the use of mercury. Recollect that the constitutional peculiarities commonly met with in patients who are the subjects of catarrh of the middle ear, are such as totally unfit them to endure the so-called 'strictly antiphlogistic' measures recommended in almost all works on ear diseases. We must be careful not to reduce our patient's vital powers; for if we do so, effusions of lymph, serum or mucus into the tympanic spaces will be probably increased; and if by loss of structure a perforation of the membrana tympani take place, there will be a deficiency of reparative power to fill up the breach and restore the functional energy of the membrane. A 'collapse' of the latter, with more or less disintegration of the ossicular chain will consequently occur. Weakly children and strumous young persons cannot bear well the frequent dosing with calomel, or even 'grey powder,' the usual panacea, according to popular belief, in all inflammatory complaints. A patient suffering from catarrhal disease of the ear is commonly disordered in general health; especially are the digestive functions disturbed. These will require appropriate treatment by medicines. If the pain in the ears, &c., ceases so as to allow of sleep without the aid of narcotics, they ought to be laid aside as soon as possible; for they almost always take away the appetite for food; and the patient is now in need of nourishment to repair breaches in structure, and to hasten the absorption of effused fluids—the products of inflammation. Lastly, with regard to general treatment, I will only observe that the more rational practice of the present day has effected a vast reform in the management of inflammatory diseases, whether situated externally or internally; and I cannot help expressing the hope that you, when in due time properly qualified practitioners, will make use of the same common sense and reasoning in the treatment of ear-diseases, which you will be called upon to apply to those of other organs of the body. An almost frightful system of general depletion, with severe and long-continued blisterings has hitherto prevailed because recommended in former works of high authority. You are compelled to adopt *local* depletory measures, for the purpose of relieving engorgements of the blood-vessels and disburdening the turgid capillaries that supply the mucous membrane of the middle ear, which is also the periosteum. Until this be done, the tormenting and dreadful pain will continue. Every one who has suffered from ear-ache (and few escape) has had proof of the intolerable nature of this pain.

Generally speaking, however, I find that its *cause* is not rightly understood or interpreted, else we should not so commonly hear of the treatment being by rubefacients, blisters, chloroform, sedative liniments, and the like. It is true that pain in mucous membranes is not a common phenomenon, for their texture enables them to expand and dilate, so that they escape much tension and pressure; but the membrane lining the tympanum and its partition walls is altogether exceptional in structure, partaking quite as much of the character of a *serous* as of that of a *mucous* membrane. Consequently the signs as well as the results which belong to inflammation of both these tissues, will be usually manifested in an acute catarrhal affection of the middle ear. Every catarrh of the tympanum may be truly said to be a 'periostitis' and we know how painful at the time, and how serious in its consequences, is an inflammatory condition of the investing and nutrient membrane of a bone. So that, in treating inflammations of these modified, or more properly, compound tissues, and adopting measures to prevent their often-times destructive sequelæ, we must be careful to bear in mind the close affinity which the so-called mucous membrane of the tympanic cavity bears to the proper serous membranes in other parts of the system. In this way, we shall understand how effusions of various fluids (such as serum, mucus, pus, or coagulable lymph which so frequently agglutinates contiguous surfaces, the formation of membranous bands, deposits, ulceration leading to perforation of the membrana tympani—persistent offensive otorrhœa, and lastly, caries of the temporal bone, with perhaps fatal intra-cranial disease), may, one or all, result from an aural catarrh affecting the lining membrane of the tympanum and mastoid cells.

The free application of leeches will mitigate the intensity of the pain by unloading the full and dilated capillary vessels which press upon the nerve filaments that ramify on the surface of bone (especially the promontory) and on the periphery of the membrana tympani. At the same time the probability of effusion will be lessened, and the desired event or termination of the inflammatory attack, viz., its subsidence or *resolution*, will be hastened. In the most favourable cases the disease will go no farther; the inflammation begins to recede, and there is very little or no appreciable effusion; or, should such have occurred to a slight extent, it is re-absorbed, and the parts return in most respects to their former condition and integrity.

Counter-irritation by blisters is, generally speaking, too much relied upon, or applied at too early a period in the disease, but as the latter advances, iodine painted on the mastoid process will be found useful.

The catarrhal symptoms in the throat must not be overlooked. In addition to the fomentations, steaming, &c., previously had recourse to, gargles, composed of opium and belladonna, will be beneficial as soon as the requisite movements of the palate and fauces can be borne. Borax, alum, creosote, iodine, &c., and astringents, may be employed at a later period.

By these means the object first aimed at, viz., *to subdue the urgent inflammatory symptoms,* will have been attained; but further measures are in most cases needful to prevent the *recurrence* of the ailment we are now considering, for it is the repetition of these attacks which is so frequently the cause of obstinate or confirmed deafness. One of the most immediate consequences of an aural catarrh is *closure of the Eustachian tube,* from the participation of the latter in the throat affection. As this imperviousness is only temporary, and will disappear on the subsidence of the acute faucial inflammation, I maintain that it is wholly unnecessary to resort to mechanical means for re-opening the tube at an early period, or until the patient can swallow without pain. On no account should the catheter be introduced while the severe inflammatory process continues, while the membrana tympani is greatly injected with blood, or when there is intense pain in the ear. When the pain and febrile symptoms have almost entirely disappeared, if the deafness be persistent and considerable; if the noises in the ear, such as blowing, singing, knocking, &c., &c., are troublesome; and lastly, if the patient be unable to inflate the drum, or ignorant how to do so, by the ordinary Valsalva process,—you may infer that the Eustachian tube continues obstructed, and should employ the Politzer method for re-opening it, without further delay.*

The obstruction being of recent origin is seldom great, and when the bag is compressed, air will probably pass freely up the Eustachian tube, and will be heard by the surgeon to enter the drum, with such sounds as indicate, with tolerable accuracy, the condition of that cavity.† The effect of inflation is sometimes surprising to the patient, and immediately beneficial to hearing. It generally brings about a restoration of the lost function, if the closure of the tube has been the most urgent abnormal condition. The little operation should be repeated daily, until the patient is able to press air into the tympanum by unassisted efforts, and the full degree of natural hearing is attained.

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* This method has been thoroughly described and illustrated at pages 105 to 107.

† For a description of these sounds, during inflation, see page 105.

Great numbers of cases illustrative of the foregoing remarks and descriptions, might be adduced; but I am desirous to avoid what I cannot help regarding as a very common mistake in professional treatises, the multiplication of cases, often with scarcely any distinctive points, and tending at least rather to the bewilderment of the student than to his instruction."

CHRONIC AURAL CATARRH.

In chronic catarrhal inflammation of the *mucous membrane of the drum*, the vascular distension and general disturbance are not nearly so great as in the acute form; and the redness of the mucous membranes which are visible is accordingly very much less, often scarcely perceptible on the faucial termination of the middle ear; while the pain is slight, or altogether absent. From this latter circumstance the patient may sometimes be quite unaware of the existence of very serious disease that has already been some time proceeding. Therefore, although in many respects chronic catarrh may appear less distressing and urgent than the acute form, we have become informed by post-mortem examinations that the pathological changes it produces in the ear are of a most serious character. These are interstitial deposits and thickening, from effusions and congestions, with such an amount of consequent structural alteration in the drum-cavity as to gradually impair or totally destroy their varied and important functions, causing more or less severe deafness.

Pathology.—In the first place we find that chronic catarrh of the tympanum results from an inflammatory state of the throat, which may have been either acute or sub-acute; and in these cases the mucous membrane of the cavity undergoes the process of hypertrophy. This thin and delicate investing membrane, naturally so fine as to require the sense of touch in aid of sight, even to determine its presence, may become so vascular, congested, and thickened as nearly to fill the whole cavity. From being "like a piece of the finest tissue paper," says Toynbee, "it becomes more like velvet." Instead of secreting just so much mucus as suffices to lubricate its surface, it pours forth viscid secretion in such excessive quantity as to occupy all the space remaining vacant in the cavity. In these cases, the Eustachian tube having been implicated in the catarrhal process, this fluid cannot escape naturally; and should it not become absorbed, it may, by pressure upon the membrana tympani, produce an orifice there, and run out into the external meatus. This latter symptom, or, more correctly, result, constitutes so frequent and important an ailment, taking its origin from more than one serious aural disease, that it will require special and detailed notice hereafter under its its name of *otorrhœa*, or discharge from the ear.

Generally, in the cases now under consideration the whole of the membrane investing the tympanic walls is involved, and neither the thickening nor vascularity is decidedly greater in one part than another. In other instances, where there is a too abundant mucous secretion within the cavity, a thinner fluid may co-exist with a thick and tenacious one, the former occasionally disappearing in the mastoid cells, or escaping through the Eustachian tube when permeable, while the latter hangs about the ossicula auditus, greatly impeding their mobility. When these mucous exudations become dry, dense, and stiff, they obviously may so interrupt the vibratile movement of the little bones, and of all the finely arranged membranes within the drum, and perhaps cover the so-called membrana secondaria at the round fenestral opening, as to act most disastrously upon the hearing powers. Thus much may suffice in reference to *exudations*.

Secondly, in pursuing our examination of pathological changes, we shall discover that the lining membrane itself sometimes becomes denser, firmer, and unyielding. This condition has been named by Toynbee, *rigidity of the mucous membrane of the tympanum*, and he has written almost a whole chapter on the subject. Whether it be possible or not to distinguish during life between cases of this description—cases of dried-up mucous collections, and those of fibrinous deposits which constitute the frequent pathological appearance called *membranous bands*—is of no great practical importance. It is unnecessary to describe these varieties of condition more fully. They all impair the motion of the ossicles; they may unite the little bones to one or another or to the walls of the tympanum; they may fill up all the angles and spaces in the cavity, or even obliterate it altogether by connecting the membrana tympani to its inner or labyrinthine wall.

Mr. Toynbee has described 136 cases of what he called *anchylosis of the stapes to the fenestra ovalis.* In my opinion this expression (anchylosis, or bony union) requires modifying, because he has applied it to those cases in which he found thickening and rigidity of the mucous membrane, as well as a similar state of the ligaments, of the stapedio-vestibular articulation, binding down and unnaturally fixing the stapes to the circumference of the fenestra ovalis. By true anchylosis, or stiff joint, we should understand that a bony union has taken place between the base of the stirrup-bone and the margin of the oval opening in which it properly ought to play somewhat after the manner of a piston in a cylinder. Sometimes such a condition is marked by an expansion of the base with new ossific matter thrown out so as to connect it with the adjacent parts of the oval fenestra; and sometimes the bony material is thrown out from the circumference of the fenestra ovalis, more especially from that rim or plate which, though it always escapes the notice of anatomists, exists, nevertheless, as a preventive to the forcible propulsion inwards of the stapes upon the labyrinth fluid. The pathological condition which results from chronic catarrh, and has been thus confounded with anchylosis, is dependent more upon contracted, tense, thick, or shrunken tissue, which holds down tightly the normally movable little stapes than upon calcareous effusions, or upon exostosis. I term this result of chronic catarrh *impaction of the stapes,* in contradistinction to Toynbee's anchylosis. Such a distinction appears to me necessary, for in the former case treatment is sometimes effectual, while in the latter no benefit can possibly be expected from it.

You will remark that some of these changes can be *seen* only upon the dead subject, because the catarrhal processes of which they are the result, may have established themselves upon parts comparatively far removed from the external membrane, as for example, on the inner wall and on the two fenestræ. In examining a living patient we are however assisted to conjecture, with tolerable certainty, that these two structures (next in acoustic importance to the auditory nerve itself), are implicated in the disease now being described, by the usually very high degree of deafness, which cannot be referred to a "nervous" affection. Any symptoms which indicate that the labyrinth-openings are partaking in the tympanic mischief, require our special study.

Chronic Catarrhal Inflammation of the Drum-Membrane.—Although the structure of the membrana tympani is very seldom affected alone, or primarily, generally becoming so by secondary implication, its aspect furnishes very valuable assistance in indicating the condition of the middle ear, and therefore importantly aids our diagnosis. If we examine the meatus of a young or middle-aged person suffering from chronic catarrh which has supervened upon the acute form, its cuticular surface will generally look swollen and moist, and it will be more or less filled with desquamated epidermis. On this account the boundary between the meatus and the membrana tympani will be ill-defined, and the superficial area of the latter consequently appears smaller. In other cases, where the disease is of a long standing, or the patient past the middle of life, all vascularity of the outer passage will have disappeared; there will be no excessive secretion or discharges, but it will be dry or scaly, indurated, rather shining, and totally devoid of cerumen. This last condition is usually associated with a pearly whiteness of the membrana tympani, and a line or two of red vessels running down the malleus handle. In others again, there is visible a flocculent exudation from the cuticular layer of the meatus and membrana tympani; the latter looks granulated and abnormally flattened, and according to the amount of this exudation, will the individual portions of the membrane be more or less indistinct. If you keep well in mind the position of the various structures composing the membrane, you will have no difficulty in distinguishing opacities caused by thickening of the *external* layer (the dermoid or cuticular) from those of the *inner* layer (the mucous). For example, if the handle of the malleus is clearly seen, it is a sure sign that all the layers of the tympanic membrane (the fibrous, or middle layer included) external to this little bone, are free from deposits; but a very considerable thickening of the mucous layer may exist without hindering our view of the manubrium and short process. So also, according to the amount of exudation in its dermoid or cuticular covering will be the *colour* of the membrana tympani. Sometimes it is orange tinted, or greyish-yellow, and unevenly spotted. In opacities which are caused by chronic catarrh of the mucous layer, the membrane is usually somewhat dull, like parchment; and if it has not completely lost its lustre, may be compared to ground glass, or glass breathed upon. Its colour is often bluish white, or dirty grey, and in long-continued cases, it passes through all the changes intermediate from "whitish-grey to a pearl white, from a bluish to a yellowish-grey" (Von Tröltsch).

The membrane is too concave, and consequently the *bright spot** is altered, becoming dimmed, striped, or reduced to a small point, and sometimes entirely absent. Blood vessels are only seen on the membrane when congestion is present, and this is not often the case, though two or three may generally be seen coursing down the malleus-handle whenever the patient attempts to inflate the tympanum by the Valsalva method. The manubrium is, as before stated, almost always distinctly visible, because it lies in front of the opaque mucous membrane. Sometimes this bone is very prominent, standing out as if in relief.

In other instances, and often, the malleus is strongly drawn inwards by thickening and subsequent retraction of the mucous membrane and the tendon of the tensor tympani muscle; so that it appears in perspective *greatly foreshortened*, in which case the processus brevis or small round tubercle at its upper extremity, becomes more prominent, and is in fact the only portion of the bone seen. The appearance is particularly indicative of long-continued occlusion of the Eustachian tube, when the whole membrana tympani presents a most marked *inward curvature*, in consequence of the air becoming absorbed withinside the drum, while the usual atmospheric pressure (of about 7 lbs.) is exerted upon it from without. But this excessive concavity is not unfrequently observed, even when the Eustachian tube is not occluded; and in such a case, if the membrane does not move outwards, or only portions of it do so, during the employment of the ear douche by the Politzer bag, or through the catheter—we may infer that adhesions exist on its inner side, within the tympanum, tying it to the walls of the latter. The movements of the membrana tympani, and the various forms which it assumes, are well brought into view by using Siegle's pneumatic speculum.*

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* See page 97.

Calcareous and atheromatous deposits which occasionally occur in the course of chronic catarrh, are easily recognized on inspection of the membrana tympani. They are by no means unfrequent, and when their presence is attended with a very high degree of deafness, it may be surmised that similar earthy deposits are present on the membrana of the fenestra rotunda, and about the foot of the stapes. Usually they form on the membrana tympani crescent-shaped or semilunar opacities of a whitish-grey colour, quite distinctly separated from the surrounding tissues. Wilde has likened them to the *arcus senilis* of the cornea. Since attention has been more particularly drawn to these calcareous masses, it has been observed that they are very various in form, extent, locality, and structure. Sometimes they involve all the layers of the membrana tympani, and sometimes may exist only in the inner mucous layer, while the outer surface is unchanged in brilliancy.

Another of the many diversified appearances of the membrana tympani which come to view, more especially when the air douche is employed, is what have been called by Politzer *"bleb-like prominences."* These may arise from loss of substance in the mucous and fibrous layers; in which case the impelled air gets between the latter (the substantia propria) and the dermoid layer; or there is a hernial protrusion of the mucous layer between the two external ones.

It is, however, only through a competent knowledge of the anatomy of the *healthy membrana tympani and of its morbid appearances in the living*, that we can ever hope to fully understand the course of a chronic catarrhal affection, and to form thereby such a correct diagnosis as shall lead to successful treatment and permanent cure.

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* This ingenious instrument consists of a speculum at one end of a small air-tight vulcanite box, and a lens magnifying slightly, at the other, through which the surgeon looks. A piece of elastic tubing communicates with the box, through which suction can be made. When this contrivance is tightly inserted in the meatus, and the air exhausted, the membrana tympani may be seen through the lens to move, either in part or wholly, and thus the adherent portions are identified. I have been several times informed that an instrument of this kind is made use of by an aged aurist to, as he states, "draw the wax" (!)

CHRONIC CATARRHAL INFLAMMATION OF EUSTACHIAN TUBE. —For a description of the anatomy and functions of the Eustachian tube, the reader is referred to page 40. It cannot be too steadily borne in mind that any abnormal condition of this canal must have an effect upon the cavity of the tympanum, and upon its external membrane. To produce impairment of hearing it is not necessary that the mucous membrane lining the tympanic cavity should always participate in the morbid changes caused by chronic catarrh at the other extremity of the tube (viz., in the pharynx, fauces, nose, &c.), for we have seen scores of cases in which the deafness has been very considerable, and of long duration, cured rapidly and completely by a few puffs with the improved Politzer bag. In such instances we may be tolerably certain that no important *structural* disease exists in the cavity of the drum, in its lining membrane, or in the membrana tympani. Were it otherwise, the mere inflation, by restoring air to the inside of the tympanum, could not have given such instantaneous relief to the hardness of hearing.

The structure of the Eustachian tube, its continuation from the pharynx, its development and functional laws, and the effects of treatment, all confirm the impression that a catarrh of its lining membrane must almost necessarily result from a similar affection in the throat. Our daily observation leads to this opinion, as well as the frequent testimony of intelligent and unprejudiced patients who, without any pressing questions, almost always tell us that their deafness has proceeded "from a cold," or what is tantamount to it, a catarrhal ailment of some kind or another, including scarlatina, measles, &c. Finally, it may be taken as an established fact, that the Eustachian tube will readily participate both in the congestive swellings and exudations resulting from chronic catarrhal inflammation of the faucial mucous membrane, and that mere continuity of surface and similarity in structure, will cause the same disease to extend up its whole length into the tympanal cavity, and produce those effects already described as most destructive to hearing. But the inflammatory process, especially in the chronic form, may, and often does, stop short in some portion of the Eustachian tube, precisely as happens with inflammations of other mucous canals terminating in cavities, but which need not here be specified.

It can be proved that any physical cause or morbid process whatever, which obstructs or closes the Eustachian tube, may, *per se*, occasion deafness of a very high degree, such as totally to debar the patient from hearing conversation unless addressed to him in loud tones, or shouted into the ears. I could adduce numerous instances in which, upon restoring the patency of this auro-tympanal canal, the extreme deafness instantly vanished. How this deafness was produced by a continuation of diseased conditions into the Eustachian tube, practical experience and a sufficient number of *post-mortem* examinations have enabled us to define with certainty. In the first place, any considerable hyperæmia, swelling or thickening of the pharyngeal mucous membrane will extend into the faucial end of the tube, and gradually pass on to the upper portion where it is naturally very narrow, and will in consequence easily become closed, and when it is closed, all communication between the throat and ear is cut off. No supply of air now being able to enter the drum, that which was contained within it at the time of closure will by degrees become absorbed, while the atmospheric pressure on the outside of the drum-head, continuing in its usual force, will press the membrana tympani as well as the whole chain of ossicles, inwards. The effect of this is, as you have several times been informed, to impede or destroy vibration in these parts to such an extent that sounds are prevented from reaching the internal ear.

This deafness to external sounds will assuredly continue as long as the tube remain impervious; even for years. In the second place, closure of the tube will confine mucus, pus, and all other secretions or exudations within the tympanic cavity, and thus bring about an abnormal condition of this part of the middle ear—a prolific source of subsequent disease, which if long continued, may terminate in confirmed and irremediable deafness. This course or sequence of aural disease, from continuity of mucous structure, is, I do not hesitate to declare, in my opinion, beyond all others in frequency and in importance. We shall, therefore, not expend our time without profit in considering most carefully the chronic catarrhal affections of the throat and naso-pharyngeal spaces, which thus so severely and injuriously influence the Eustachian tube and tympanum. One of the most immediate and commonest causes of *obstruction of the Eustachian tube is thickened* *mucous membrane.* A general hypertrophied state of the lining membrane of the fauces, soft palate, and posterior nares, is observed most generally in children and young persons of an unhealthy or scrofulous constitution. Occasionally all the mucous surfaces which can be brought to view on looking into the throat are reddened, congested, and swollen ; and if at the same time the tonsils are enlarged, the boundaries and borders of the palatine arches are so approximated as to narrow and almost close the entrance into the pharynx.

An enlargement of these glands (the tonsils), so great as to make them meet in the centre, much interferes with deglutition and respiration. Small or soft morsels of food only are swallowed, and the child snores in its sleep, breathes habitually with the mouth open, and articulates badly. Sometimes, besides touching on the median line, the tonsils encroach upwards, towards or beyond the fine border of the soft palate, and downwards so low as to be hidden from view until the base of the tongue is pressed down. The mucous membrane covering them is almost always thick, and seldom without redness and increased vascularity. The diseased tonsils present an uneven, pitted surface, sometimes ulcerated in spots, very commonly small points of thick tenacious secretion of a yellowish color and muco-purulent character, exude from it, marking the orifices of some of the ducts which lead into the substances of the gland-tissue. This vitiated sticky exudation collects especially during the night, and covers the fauces and upper walls of the pharynx; doubtless also getting into the Eustachian tubes and preventing the free renewal of air in the tympanum when their mouths are opened. In these cases, as in others where the enlarged glands project above the soft palate, *deafness* is usually complained of, but this symptom is only a concomitant, and is not caused by actual pressure of the tonsils upon the orifices of the Eustachian tubes so as to close them, as was formerly supposed by Dr. Yearsley. The deafness appears rather to depend upon the thickened condition of the mucous membrane which extending from the tonsils and fauces, runs up into and lines the tube. For this reason there is always danger of chronic catarrhal affections producing deafness, even when the tonsillary enlargement is not great. Although the tonsils do not encroach so high up as to press directly upon the orifices of the tubes, they may cause a displacement of them by pushing up the posterior arch of the palate and the base of the uvula, occasioning much difficulty in passing the catheter, or even preventing altogether its being introduced.

Among the causes of defective hearing is also the growth of "vegetations," which spring from the walls of the naso-pharyngeal cavity. Sometimes they occur in groups, and smaller harder ones are found on the inner surface of the Eustachian tubes themselves. They frequently accompany chronic tonsillary disease, and a thickened or swelled condition of the soft palate, greatly impairing the mobility of the latter, and materially interfering with speech. The patient's voice is truly said by Dr. Meyer to be "singularly wanting in resonance, and the usual consonants cannot be pronounced, exactly as in a common cold; patients thus affected being unable to pronounce the nasal sounds, '*m*' or '*n*,' will say, 'cobbod' instead of 'common,' 'doze' or 'lose' instead of 'nose,' 'sogg' for 'song,' and being likewise unable to breathe through the nose, they are compelled to keep the mouth continually open." These vegetations or granulations act injuriously by keeping the surrounding mucous tissues in a state of chronic swelling, and in a reddish, puffy, infiltrated condition, which favors hypersecretion in the Eustachian canals. This will gradually increase, and be propagated to the tympanum, there to set up catarrhal symptoms of a more acute description, which may lead to obliteration of its cavity, or to what is less disastrous—perforation of the drum-head. Lastly, after what has been said regarding the multifarious causes of Eustachian-tube obstruction, you will be prepared to comprehend that "*ulcerated sore throat*" (to use the familiar term which is so well understood by everybody), hypertrophy of the pharyngeal glands, tumours of the soft palate and fauces, &c.—in fact, any morbid or catarrhal affection whatever which interferes with the perfect action of the Eustachian tube or its muscles, may impair the hearing temporarily, severely, or permanently.

Congenital fissure or "*cleft palate*" is a cause of deafness by deranging the action of the palatine muscles (which are, as you know, also muscles of the Eustachian tube), and otherwise by thickening the continuous parts of the mucous membrane. The effects being catarrhal, I must notice them. Dieffenbach has shown that "most patients with cleft palate are hard of hearing."

In addition to *mucous plugs and coverings* at the orifices of the tubes, nasal or pharyngeal *polypi*, large *ulcerated surfaces* (specific or otherwise), *membranous adhesions*, *stricture*, and other conditions more rarely occurring as causes of obstruction in the Eustachian tube, I must not omit to mention what is called *relaxation of the mucous membrane of the fauces.* I do not class this latter affection with those just described as thickenings, though the symptoms are not dissimilar, because it more generally occurs in adults, and persons who are debilitated from overwork, and are subject to indigestion. It also is seen in those who are over-indulgent, and irregular in their habits.

The physical cause of the obstruction (as described by Toynbee) appears to be a relaxed condition of the mucous membrane covering the faucial orifice of the tube, so that its muscles are unable to separate the lips sufficiently to admit air. The exciting cause is often a cold. There is usually no history of a previous disease of the ears, the deafness coming on slowly, and gradually increasing until the patient is unable to hear ordinary conversation, and requires to be spoken to in a loud tone of voice. It is remarked by Mr. Hinton that "those who smoke to excess are especially liable to deafness from this cause." My own observations, however, have hitherto failed me in tracing the infirmity to such a habit.

Middle-aged patients suffering in this way are generally weak and debilitated, looking pallid and out of tone. On examination, the mucous membrane of the fauces is less red than usual, or pale and flabby; it may be hanging in folds on each side the arches of the palate, and traversed by streaky blood-vessels or distended veins. The "*relaxed uvula*," in consequence of the palatine muscles having lost their contractile power, is too pendulous, sometimes hanging so low as to touch and rest upon the dorsum of the tongue. The term "relaxed" does not, however, always describe correctly the altered condition of the uvula, for it may be thickened and not elongated, but the latter is the more usual appearance. It may be œdematous, infiltrated with serum, and softer than natural, or obliquely placed between the tonsils and the arches of the palate. Occasionally, on attempting to pass the catheter, after failure of inflation by the Politzer bag to restore patency in the tubes, we come upon a projecting mass of relaxed mucous membrane which has arched the soft palate forwards, and gives a peculiar "doughy" feel at the end of the instrument. I have several times found resistance to the passage of the latter into the Eustachian tube from such folding of the membrane which seems to act like a valve at its faucial orifice. Such are instances of *relaxed* mucous membrane.

Chronic Catarrhal Inflammation of the Mastoid Cells.—As it seems to be doubtful whether the mastoid cells are ever primarily affected, and without contemporaneous disease of the tympanic cavity, I have not noticed their pathology before when treating of the acute form of aural catarrh. That they become secondarily affected, by extension of inflammatory action from the tympanum, is a matter of every-day experience.

Perhaps the only exception which can be allowed in respect of an idiopathic affection, in which the tympanum is not involved (or does not appear to be involved), is when certain fatty, chalky, scrofulous or other deposits occur in the mastoid cells, and are not at the same time found in the tympanum. In otitis, or the purulent form of aural catarrh, the mastoid process seldom escapes implication; but this serious disease, leading occasionally to a fatal result, belongs more properly to a future part of our subject, and will be attended to later. We cannot, however, understand the pathology of the mastoid cells, nor even how far a chronic catarrh in them affects the hearing, until we have acquired a clear idea of their functions and physiological importance; for in this way only can we determine the amount of significance to be attached to any particular manifested disease in these parts. Mr. Toynbee pointed out, that at birth and during childhood, the mastoid process is in a rudimentary state, and its form is very different indeed from what it becomes later on in life. He also carefully demonstrated by dissection and *post-mortem* examinations of the temporal bones of children who had died of caries and abscess in the brain from the effects of catarrhal inflammation, that disease occurring in the mastoid process during childhood produces entirely different results from those which follow it when occurring at a later period. You must therefore make yourselves thoroughly acquainted with the peculiar conformation of these cells, and their anatomical relations to the tympanum, before entering upon the study of their diseases. By dissection with your own hands, and not from descriptions given by another person, can such knowledge be obtained.

With regard to *function*, the mastoid cells may be considered as an amplification of the tympanum, or an appendage to that cavity. It seems to be an accepted opinion that this porous, light, yet firm and stable cellular structure acts as a sort of reservoir for air to the drum, with which the cells freely communicate. Being placed immediately opposite to the entrance of the Eustachian tube, air easily passes into the mastoid cells, and is set in motion by acoustic vibrations impinging upon the membrana tympani. And when that membrane is extensively perforated, or lost through disease, the air contained in this amalgamated cavity is influenced greatly by the sonorous impulses from without. By bearing the last-mentioned circumstances in mind, you will understand how an excellent degree of hearing may be attained, even under such deficiency, when the little plug of cotton wool (Yearsley's artificial tympanum) is inserted against the ossicles, or sometimes against the stapes, if that be the only one remaining.

It has often happened, that when the mastoid cells have been filled up, by congestive swelling of their lining membrane, or by accumulations of mucus, pus, &c., and the air contained in them has thus become greatly diminished, the membrana tympani has suddenly burst during sneezing, coughing, or a violent blowing of the nose; and my opinion is, that were it not for this auxiliary arrangement of pouches into which air may be occasionally compressed, any sudden loud, and unexpected sounds, such as gun-firing, the explosion of shells in warfare, or even a box on the ear, would cause rupture of the drum-head to be much more frequent than it is. In truth, it is quite an allowable "scientific use of the imagination" to state that if the tympanum (which is only the size of a small nutshell) were the sole air-containing cavity, few of us would be in possession of a sound unruptured drum-head.

SYMPTOMS OF CHRONIC AURAL CATARRH.

Deafness is generally the most prominent symptom complained of in chronic aural catarrh, although it may be so trivial in degree that attention has not been seriously called to it until *singing* in the ears, or some other distressing sensation has become sufficiently urgent to impel the patient to seek advice.

The defect in hearing has perhaps increased so gradually and imperceptibly that no particular time or cause can be assigned. Catarrhal affections of the middle ear so frequently have commenced in infancy or childhood that there is difficulty in getting *history,* and in reply to the question as to "duration of disease," we are often told, "I was deaf from infancy," "I never recollect hearing well," and the like. Again, if the patients' attention has not been drawn to their infirmity by pain, tinnitus, irritation of the ears, or any other unusual sensation, it is quite common for them and their friends to consider the case as one of "nervous deafness." Fortunately, however, this illusion is dispelled in a large proportion of these instances by our modern and more exact methods of examination. This slow and insidious advance of deafness indicates that the mischief is more serious, probably thickening of the mucous membrane of the tympanic cavity, but the degree of deafness depends not so much upon the amount or extent of the thickening, exudations, or depositions, as upon their situation. For instance, we find that extensive morbid alterations, and even losses of structure in the membrana tympani and the mastoid cells may occur without much hardness of hearing; while on the other hand, very slight changes or deposits on the membrane covering the fenestræ and in the parts which conduct sound to the labyrinth, will impair hearing to such an extent as to cause almost total deafness. The *degree* of deafness will consequently, with other symptoms, indicate tolerably well the locality implicated.

Tinnitus, or singing in the ears, is one of the many symptoms, and the commonest subjective one, and often forms the principal complaint, when the deafness has slowly stolen on. Wilde,* describing these aural sensations, says:

"Noises in the ears" is certainly one of the most distressing, as well as the most frequent symptom attendant upon affections of the organs of hearing. It is one common to almost all, and peculiar to none of the diseases of the ear. Like muscæ volitantes in the eye, it may exist as an isolated symptom, or it may be an attendant upon several aural diseases. It is often caused by cerebral disease; it is sometimes an accompaniment of derangement of the circulatory, digestive, or uterine organs; of congestion of the brain, hemorrhage, hypochondria, hysteria, chlorosis, anæmia, typhus, influenza, or simple catarrh; of closure of the external meatus, obstruction of the Eustachian tube, and impaction of the auditory passage with wax; a foreign body, or even a hair resting on the tympanal membrane, as well as engorgement of the lining membrane, or mucous collections in the tympanic cavity, and also nervous deafness —these will all produce it. Furthermore, we may remove the original disease, give a healthy action to the affected organ, and restore its function, yet the noise will remain. So great is the discomfort which it gives that persons incurably deaf, and who are quite conscious of the impossibility of restoring their hearing will still apply to be relieved from this haunting and most annoying symptom. The peculiar characters of the *tinnitus* and the noises to which it is likened, are as variable as sound itself. I think the descriptions which patients give of the noise which they experience depend, to a certain degree, upon their fancy, their graphic powers of explanation, and not unfrequently upon their rank in life, or the position in which they have been placed, and the sounds with which they are most familiar—thus, persons from the country, or rural districts, draw their similitudes from the objects and noises by which they have been surrounded, as the falling and rushing of water, the singing of birds, buzzing of bees, and the waving or rustling of trees; while, on the other hand, persons living in towns, or in the vicinity of machinery or manufactures, say that they hear the rolling of carriages, hammerings, and the various noises caused by steam engines. Servants almost invariably add to their other complaints that they suffer from "the ringing of bells" in their ears. The tidal sound, or that which we can produce by holding a conch-shell to the ear, is, however, most frequently complained of. Sometimes the tinnitus exists as an isolated symptom; but in several such cases I have remarked that sooner or later either aural or cerebral disease manifested itself. Removing the cause, and curing the deafness will often, but not always, relieve the patient of the noise.

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* "Aural Surgery," pages 83 and 84.

My present object is to treat of this subjective aural symptom only so far as it relates to and depends upon a chronic catarrhal affection of the ear. Morbid anatomy, more accurate methods of examination, and a stricter observation of the physical signs accompanying this disease, have in a great measure cleared up the mystery surrounding the production of "noises in the ears or head." As chronic catarrh is the commonest form of deafness, so is tinnitus aurium the most frequent result or sign of it. I will briefly enumerate the abnormal conditions of the various parts of the middle ear which appear to be the usual exciting causes of this disturbing symptom. First, the state of the membrana tympani. In acute catarrh of this part it is always present (see page 144), and we likewise find tinnitus accompanying the more chronic form of catarrh when there is overtension, or the opposite condition of collapse, or whenever the membrana tympani is rendered invibratile. Pressure of wax, and fluid or thick discharges on the outside, accumulations of serum, mucus, or other fluid, or semi-fluid collections, earthy or fatty deposits, and membranous bands on the inside, are causes of tinnitus. Even such hyperæmia and slight amount of hypersecretion of the mucous membrane of the tympanic cavity as occurs during an attack of influenza, common cold, or sore throat, or when there is increased circulation from indulgence in stimulants, taking quinine and strong ferruginous tonics, are all causes sufficient to give rise to tinnitus, and if, in addition, the Eustachian tube be closed, the noise in the ears is sure to be aggravated. The supposition that the condition of the membrana tympani is the chief agent in the production of tinnitus aurium derives strong probability from the fact that when a perforation of it, or any large loss of its substance from ulceration or the suppurative process occurs, through which secretions, &c., from within the tympanum are freely discharged, tinnitus is scarcely ever present. The noises also cease when we incise or perforate it artificially, so that this operation is occasionally submitted to by patients for the purpose of obtaining relief from them.

Now, remembering what has been stated regarding the functions and diseases of the tympanic structure, and noting the foregoing instances, you will not have failed to perceive that tinnitus has depended upon some abnormal pressure upon the nervous expansion in the labyrinth. The membrana tympani presses the ossicula inwards, and therefore the base of the stapes upon the fluid where the auditory nerve is distributed; or it may be so rigid, tense, and unyielding, that the secretions within the drum press unduly upon the still more delicate membrane of the fenestra rotunda. Thickening and great tension of the lining tympanic membrane do the same thing. When, in a case of aural catarrh, tinnitus and deafness are simultaneous in their commencement, they will increase proportionately, and it is obvious that in this instance both must depend upon some alteration in the conducting apparatus, by which its acoustic properties have been interfered with. For example, a little film of mucus, spread over the inner side of the membrana tympani, is sufficient to alter the periodicity of its atmospheric vibrations, or even partially to quench them. Thus, deafness and tinnitus will co-exist here. But as soon as the removal or dispersion of the coating from the membrana tympani occurs (generally indicated by a pop or crack), both symptoms will together instantaneously vanish, perhaps never to return until the next attack of catarrh. We are amply warranted by facts like these in concluding that the membrana tympani is generally in some way or another concerned in causing tinnitus.

Sometimes distension of the blood-vessels in the tympanic cavity renders the circulation within them audible to the patient, who is sensible of a kind of "beating sound," which can be diminished, or altogether stopped by pressure upon the carotid artery. So resonant, in fact, is the cavity of the drum, that we find provision made against the occurrence within it of even such minute noise as the contraction of the fibres of the tiny ossicular muscles. These are shielded in bony canals, and only their slender tendons enter the drum, to become attached to the malleus and stapes. Paralysis of the tensor tympani, or, as shown by Politzer, shortening of the tendon belonging to this muscle, may, whether accompanied or not by any other condition tending to increase intra-auricular pressure, of course cause most troublesome tinnitus; so that the almost universal occurrence of this symptom in chronic catarrh may be expected.

Next in frequency to interference with the membrana tympani, arising from one or other of the pathological changes above referred to, I am inclined to place closure of the Eustachian tube as the most common cause of "singing in the ears." This also, on analysis, proves to be such, not directly, but in the manner following:—A closed tube necessitates a too great curvature inwards of the membrana tympani, and consequently an abnormal pressure upon the nervous expansion within the labyrinth, as has so repeatedly been explained.

Another characteristic symptom in chronic catarrh bearing some analogy to tinnitus, is a feeling of *heaviness and fullness* in the ears, as if they were "stopped up," which is increased by any cause producing interference with the aural or cerebral circulation. A hearty meal, drinking wine, violent or unwonted exercise, or any similar excitants and stimulants will sometimes occasion it, and so will mental or bodily fatigue, nervous depression, sedentary occupations and too close application to study. These sensations or some form of tinnitus, usually accompany every severe cold in the head, and they will sometimes linger after the high degree of deafness has passed away, although more commonly they increase or decrease, *pari passu*, with the hearing power. We must consider these cases as less hopeful of relief, or cure by treatment, than those in which the impairment of hearing is unattended by any of the subjective symptoms we are now discussing; because, when they persist, actual pathological changes are probably added to the hyperæmia of the tympanic mucous membrane.

Certain blowing, hissing, or pulsating sounds occasionally complained of, may be referred to some irregularity in the vascular system of the middle ear. Enlargement or even constriction of the capillaries in the tympanum would transmit a noise to the labyrinth,—so extremely resonant is the former portion of the organ; and I agree on this point with Dr. Jago, rather than with Mr. Hinton, who thinks "it may be held probable that any considerable amount of tinnitus seldom exists without somewhat of morbidly increased irritability of the auditory nerve." * The above-mentioned symptoms of fullness and pressure in the ears may increase to severe headache; great nervous irritability, vertigo, and even sickness may also occur. These appear strange ailments to be thus connected with a chronic aural catarrh, yet we not unfrequently find that a purely *local* treatment relieves the patient from them, especially when the air-douche is used. A feeling of lightness, quiet and freedom takes the place of noise, fullness and oppression.

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* The pathology of this subject has, I would fain believe, made progress since Mr. Hinton, in his supplement to Toynbee's work (1867), wrote (page 463), "It would seem better that the causes of tinnitus should be held as yet a very open question."

Time will not permit me to go into this matter so fully as I could wish. The significance of tinnitus, as almost invariably a concomitant of chronic aural catarrh, is certainly better understood at present than formerly, and therefore, it ought now to be less empirically treated. The subject may perhaps be summarized by saying that those forms of tinnitus which relate most to sensation, may be considered as a kind of neuralgia of a reflex character, induced by contemporaneous affection of the nerves belonging to the tympanum and adjacent part, such as the trigeminus, glosso-pharyngeal, the otic ganglion, and sympathetic plexuses; while the severer symptoms of the same class, such as vomiting, and vertigo, &c., are to be associated with intra-auricular pressure (that is, pressure upon the labyrinth fluid, or on the auditory nerve-expansion itself), in a manner already explained.

The facts referred to in the foregoing pages, and the observations and deductions to be drawn from them, *must* be made thoroughly your own, if you would avoid the common error of imputing tinnitus, really arising from catarrhal inflammation of the middle ear, to a *primary* affection of the auditory nerve. Unless we are able to connect this most important, distressing, and undefinable symptom, with the discoverable morbid conditions in the ear itself, we shall never diminish the number of cases of "nervous deafness," so called,—certainly shall never reduce them to the proportion afforded by my own experience, that is, to about one per cent. of all aural diseases.

The appearances of the *throat,* in both acute and chronic aural catarrh, have been rather fully described when speaking of those parts of the middle ear most immediately connected with the naso-pharyngeal mucous membrane; (see pages 151–169, the Eustachian tubes).

The more closely we study the throat symptoms in all aural diseases, the more frequently shall we find facts demonstrating that pharyngeal affections, of whatever nature or origin, are most intimately associated with catarrhal inflammations of the ear. Accumulations of phlegm, or the opposite condition of unusual dryness of the throat and nose, the altered character of expectoration, the odour of the breath, a certain difficulty of swallowing, the tickling cough, the open mouth through which the patient habitually breathes, snoring, thickened speech, &c., &c., are all local symptoms which more or less declare themselves in a deafness which has been primarily caused by a throat affection, and then has continued. These are such common accompaniments of chronic aural catarrh, that it would be a waste of time to describe them more in detail. Though patients may oftentimes forget to specify that they have experienced any or all of them at some period during the course of their malady, yet upon being closely questioned, they will generally be able to refer the accession of their deafness to some such evidences of throat ailment. The soft palate, fauces, nose, Eustachian tube, pharynx, cavity of the drum, and salivary glands, are very fully supplied with nerves, both motor and sensory, of varied origin and distribution; and that, therefore, when these parts are morbidly affected, other organs, though remote in their position, easily become involved. There are few portions of the human organism which are brought into such intimate and various connection with different nerve tracks, as is the throat; and it follows as no matter of surprise that catarrhal disease of an organ so near and directly continuous with the faucial mucous membrane as the middle ear, should sometimes remain long after the primary ailment has been forgotten.

The *pain* occurring in this form of aural catarrh is certainly not a prominent symptom; not indeed a frequent one; but when it continues for a long time, it is generally indicative of a more subacute stage in the disease. Usually felt when the patient is exposed to cold blasts of wind, or draughts, it is described as "gnawing" or "biting" in character, and will be only transient. If closure of the Eustachian tube have ensued rapidly from adhesive inflammation, and evidences exist of thickening and other structural changes, and of deposits in the tympanic cavity, severe pain will sometimes occur.

DIAGNOSIS OF CHRONIC AURAL CATARRH.

We have seen of what high value is the assistance of auscultation in the diagnosis of all chronic aural catarrhs. By its practice we become informed whether the Eustachian tube is freely or moderately penetrable by a stream of air, whether the same canal is swelled or constricted in calibre, and whether there is any unusual amount of mucus either in the tube or in the tympanic cavity. Subsequently, by inspection of the membrana tympani, and studying the mechanical effects produced upon it by the air-douche, together with other general observations, we shall probably have determined with some precision the nature of the alterations which have caused the impairment of hearing.

It is necessary, however, to guard carefully against inferring too much from any one mode of diagnosis. An inspection, however accurate, of the membrana tympani only, is not sufficient to enable us to judge decisively of the amount of deafness, nor of the nature of the morbid processes going on within the cavity,—although as a rule, it will furnish valuable information with regard to both. Neither does the employment of the air-douche in any of the ways specified, combined with a very correct estimate of the results of inflation, alone guide us to unerring conclusions as to the condition of the ossicles, the important fenestral membranes, or the membrana tympani. For example: an aural catarrh that has localized itself in the drum-cavity will cause little or no alteration in the Eustachian tube, and therefore would not be diagnosed by auscultation; yet in such an instance, the impairment of hearing is probably the result of a morbid state of the tympanum, which has been primarily induced by inflammation and afterward closure of the Eustachian tube. The catarrh of the tube may have terminated in resolution, and its patency become restored, while the products of inflammation have remained in the drum and cannot escape.

In the diagnosis of *obstructed Eustachian tubes*, most essential help is afforded by the use of the inflating bag or catheter, and by inspection of the membrana tympani during and after the operation, I shall touch once more upon the most important points to be observed by the surgeon in making his examination.

The *evidences* of an obstructed Eustachian tube are chiefly as follow:—a changed position and altered curvature of the membrana tympani. It is too concave, and looks sunken inwards, especially in the central portion. The malleus-handle appears on this account foreshortened, and lies nearly horizontal to the meatus, while its rounded tubercle or short process becomes very prominent—like the head of a large pin—near the upper circumference of the membrane. The membrana tympani being thus drawn inwards, and perhaps adherent to the promontory, the latter is seen shining through it. The vertical process of the second bone in the ossicular chain (the incus) on which the membrane in such a case often lies, is occasionally to be distinguished. From these causes, the triangular spot of light is altered, or may be altogether absent. Sometimes one-half only of the membrane is depressed and indrawn, in which case it is generally the anterior segment. The colour and consistency are altered. It may look thinner, as in atrophy of its fibrous layer, and flabby, presenting the aspect called by Wilde "collapse;" and if air can be forced through the Eustachian tube, to drive it from within outwards, or Siegle's apparatus be used to suck or draw it outwards, portions of it may be seen to move in this direction, and then to fall back again to the former position. If, however, thickening has resulted from the chronic catarrh, the signs of a previous closure of the tube are not well marked, because the membrane will be less movable.

If only certain portions of the membrane are either thinned, thickened, or adherent, such alterations will of course become very distinctly visible under inflation or suction. The appearances indicative of accumulations and deposits within the cavity, which are the consequence of prolonged imperviousness of the tube, will be recognized in individual cases, and they have been mentioned before.

Pathological investigations have proved that in some very rare cases of decided catarrhal deafness, no abnormal changes whatever were visible on the membrana tympani. Such instances, however, are most exceptional, for whenever the membrane lining the cavity of the tympanum is much affected, the mucous layer which is continued upon the drum-head is in the same morbid condition, and this can (almost invariably) be recognized on inspection.

Each case must be carefully analyzed by itself, for the mechanical effects produced by catheterism and by the air-douche, are never precisely alike in any two instances;—so much depending upon the nature and degree of closure of the tube, the amount and character of fluid secretion in it or in the cavitas tympani, the firmness and extent of the abnormal adhesions, and so on. Other valuable aids in the diagnosis are available: such as the history of the case, the patient's statements; the origin of the disease; the kind, duration, and degree of deafness; the external influences, if any, which affect hearing; whether it is better in a noise; and whether high or low sounds are the more easily distinguished. Examine the throat, nose, &c., and ascertain if sudden changes in the hearing power are apt to occur; for if they do, it may be assumed that the Eustachian tube is in some way more involved than the cavitas tympani. Some patients will state that they always hear better in dry weather, and that when the atmosphere is charged with moisture, their hearing power diminishes. These hints should be taken advantage of; for they lead to the inference that the mucous membrane lining the tubes is in a thickened and congested state, and that the slight additional swelling or secretion which during wet or foggy weather always takes place in membranes accessible to the air, is sufficient to bring the inner walls of the tubes together, thus rendering them less pervious to air, or sometimes entirely obstructing its passage into the drum. Hence you find that some improvement is occasionally obtained by such patients resorting to the Valsalva method of inflating the drum by swallowing with the nostrils closed. Again, when the deafness is not variable, nor the hearing improved by restoring air to the interior of the tympanum through any of these means, it may be assumed that the mischief lies in that cavity. Also, if the hearing power be very seriously impaired, although the auditory nerve is ascertained to remain unaffected, it may be safely diagnosed that structural alterations have occurred at the two fenestræ which lead into the labyrinth.

At this point, I must ask attention to what is called by Von Tröltsch "a great gap in our knowledge." He says "We have no means, as yet, of determining on the living subject, the particular seat of the morbid changes, that is, any more exactly than has just been indicated."* He also quotes Politzer on this point, who says "We have no way of determining whether a given impairment of function depends on an adhesion of the head of the malleus to the upper wall of the tympanum, for example, or upon a diminished mobility of the stapes in the fenestra ovalis." Von Tröltsch adds "Perhaps an examination with the tuning fork may lead to some conclusions on this point." Another author,† writing so lately as 1872, says, in reference to anchylosis of the stapes, "I do not know any symptoms by which it can certainly be distinguished during life."

"We assuredly may diagnose rigidity of the ossicles or anchylosis of the stapes, by careful attention to the symptoms accompanying their progressive stages, by the history of the case, and by observing the degree of loss which the patient has sustained over what I term the power of adjusting the ear to receive certain vocal or other sounds."

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In attempting to determine with exactitude, in any given case, which part of the tympanic cavity is especially implicated in the catarrhal process, we have to study most carefully, in addition to the diagnostic evidences already explained, what particularly auditory *function* is lost or interfered with. For instance, suppose a patient presents himself who is not very deaf, since he may hear tolerably well what is said to him while you speak slowly and distinctly, but he complains of being unable to follow general conversation, and requires to make a sustained effort of attention even when he is addressed by a single voice. We know that this one has lost the power of rapidly *adjusting* or *adapting* his ear to the tone of the speaker's voice. Or again, as I sometimes find to occur with persons who have cultivated a high power of musical discrimination, he has become unable to detect, as heretofore, any slight departures from correct tune and time in an orchestral performance.‡ If, in such a case, on examining the membrana tympani by inspection, &c., we find it tolerably healthy, and properly moveable under inflation through the Eustachian tube, and that there is no evidence or history of nerve lesion, we may infer that the stapes has become restricted in its movements, or abnormally fixed in the fenestra ovalis, whether by rigid, dense, or thickened mucous membrane, by stiffened exudations or some of the many varied forms of adhesion which result from chronic catarrhal inflammation. This condition I have termed "*impaction of the stapes*," and its effects are perfectly explicable by the fact that vigorous and sustained action of the stapedius muscle is requisite to move this, the last bone of the ossicular chain, and to keep it in the continued motion that regulates the pressure on the labyrinth fluid, and the tension of the round fenestral membrane through which all the finer and more delicate sound-vibrations must pass to the auditory nerve. We know that it is the contraction of the stapedius muscle, and not of the tensor tympani, which is needed thus to influence the labyrinth structures (the aural lens), because the prolonged effort of attention thus exercised causes such fatigue as to be sometimes insupportable; and furthermore, because unless this act of the will is sustained the sounds of a voice, or the time and tune of musical sounds cease to be perceived.

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* Von Troltsch "On the Ear," page 334. Dr. St. John Roosa's translation.

† Hinton "On Diseases of the Ear," in Holmes's Surgery, page 310. Edition 1870.

‡ The pitch of sound depends entirely upon the number of vibrations of a sounding body, the more rapid the vibrations the higher the pitch, and *vice versa.* 'Reciprocation of sounds" is associated with various degrees of tension of the tympanic membrane.

Thus much by way of proof that Politzer's "diminished mobility of the stapes" *can* be distinguished from "an adhesion of the head of the malleus to the upper wall of the tympanum." Were further illustrations wanted to prove conversely, that the latter disease is distinguishable from the former, and also from others, I might adduce the fact that it is next to impossible for such a condition to exist without impairing the free motion of the membrana tympani when subjected to inflation from within or to suction from without; nor would its appearance, colour, lustre, &c., remain unaltered. Certain sounds or tones would be heard, and others excluded: such vibrations only would be perceived as were able to be "reciprocated" by the degree of tension in which the membrana tympani was held by the immobile malleus. The contractions of the tensor tympani would be nullified, because the muscle would be unable to move the bone; but no fatigue would be experienced in the repeated attempt to do so, owing to the different mode of innervation of this muscle as contrasted with the stapedius. Many other physiological and pathological facts could be brought forward to show that affections of particular parts of the tympanum are as easily and as certainly distinguishable as are diseases of the iris from those of the lens in the eye.

Another interesting symptom, which has been said by Mr. Toynbee,* and repeated by Mr. Hinton,† to be characteristic of the later stages of "anchylosis of the stapes, or rigidity of the mucous membrane of the tympanum," is, *the hearing better in a noise*, as while riding in a carriage over a hard road, or during the beating of a drum. The first-named writer attributes the improvement in hearing manifested under these circumstances to "considerable vibration communicated to the body, which shakes the chain of bones and imparts to them a kind of vibratory movement, permitting the muscles while it lasts so to act on these bones as to restore more or less of their proper functions in adjusting the pressure on the labyrinth." The latter author does not explain the cause of the phenomenon, but admits it to be "common to this with some other morbid conditions." I myself cannot conceive it possible for bodily shakings and sonorous vibrations like the above to affect so decidedly a rigid ossicular chain and mucous membrane without at the same time injuriously influencing the more delicately organized and more vibratile parts of the labyrinth, such as the perilymph and round fenestral membrane, so as to produce utter confusion of all intelligible sounds. I am obliged to consider the foregoing interpretation of the very common symptom "hearing better in noises" as entirely erroneous; and (to my mind at least), it simply illustrates the necessity of bringing physiological reasoning to bear on pathological facts. You must not from this symptom diagnose the existence of any such severe catarrhal affection as "immobility of the stapes and rigidity of the tympanic lining mucous membrane." But you may assume that morbid structural changes have occurred at the other and outer end of the ossicular chain where the other muscle of the drum (the tensor tympani), which is excited to action by the stimulus of these noises, can be influenced. A case is recorded where a man could only converse with his wife while a servant beat a drum. In another instance, a shoemaker's son could understand what was said to him only when he stood near his father pounding leather on the lapstone, so that when the latter wished to speak to his son, he took the hammer and pounded away at the leather. This boy could also hear well inside a mill, but outside of it voices were unintelligible. It is the membrana tympani which is the structure principally affected when the symptom in question is prominent.

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* Toynbee's "Diseases of the Ear," page 281.

† Hinton "On Diseases of the Ear," in "Holmes's System of Surgery," edition 1870, page 310.

We have now, by accurate observation and analysis of symptoms, and the careful use of instrumental aids, ascertained (it may be supposed) the seat and description of chronic catarrhal disease in the middle ear, or, to speak technically, we have formed our *diagnosis* or *recognition* of the ailment. The next step is to determine, if possible, whether the resulting deafness is completely curable, whether it admits of relief by a slow or by a comparatively speedy process, whether we can hope by treatment to arrest the advance of disease, and so retain such hearing power as may still exist, or finally whether the probable ultimate event will be complete and hopeless loss of hearing. These are all points of extreme importance to the patient, and upon which we are often eagerly questioned by him. This estimate and foreknowledge of the career and termination of a disease is its *prognosis*, and varies, of course, with the almost infinite variety of cases—yet, by correct diagnosis, founded on a thorough acquaintance with the nature of the malady itself, we will be enabled in the great majority of instances, to arrive at it with accuracy, even in such an obscure and uncertain class of affections as we are now considering.

TREATMENT OF CHRONIC AURAL CATARRH.

The treatment of chronic aural catarrh will consist chiefly in altering the morbid condition of the drum membrane, the mucous membrane of the drum cavity, Eustachian tube, pharynx, nose, &c., and in restoring as far as possible, the right position of the ossicula auditus; likewise, in attending to the general health of the patient.

The *membrana tympani.* We shall seldom find its morbid appearances to be due to chronic inflammation of its structure alone, for this state will be either associated with or have resulted from a diseased condition of the drum cavity. The treatment will be the same in both instances. When there is thickening and general hypertrophy of the fibrous laminæ (a state frequently connected with the gouty or rheumatic diathesis) we should, in addition to local applications, prescribe such constitutional remedies as are efficacious in gouty or rheumatic ailments. With a hope of clearing off the opaque spots which stud the surface of the membrane, it is recommended to apply, with a camel's-hair brush, or on a piece of cotton wool wrapped round a probe, a solution of the nitrate of silver (grs. v—xx to ℥ j. of water).

Some darkish scales of dermis peel off, and occasionally we find the membrane thinner, and a little more transparent after repeated applications. The deafness, however, not being dependent upon the condition of the membrana tympani alone, is seldom thus benefited, but annoying tinnitus may sometimes be relieved. A few drops of sulphuric or acetic ether, or of spiritus camphoræ combined with liq. morphiæ, ʒ j. of each, to ℥ j. of glycerine, will occasionally answer the same purpose.

In relaxation, thinning, or atrophy, when the membrane may look like crumpled paper, and depressed spots, resulting from some loss of its substance, are observed, astringents, such as zinci sulphat: (grs. v—xx ad ℥ j.) liq., plumbi. diac: ʒ j. ad ℥ j., &c., poured into the ear, and allowed to remain for a few minutes, do good. I also recommend, for the purpose of relieving the troublesome "noises," an application composed of equal quantities of atropiæ sulph: and liq. morphiæ hydrochl: with camel's-hair brush. But the best remedy where the deafness is considerable, and there is reason to suppose that the ossicula are disarranged or dislocated by the previous catarrhal processes within, is Yearsley's "artificial tympanum."* This, when carefully adjusted, will in some cases give instant and marvelous relief to the deafness. It acts by supporting the ossicles, and maintaining them in a position to convey vibrations across the tympanum, and give thereby the needful degree of tension to the membrana fenestræ rotundæ.

In the greater number of cases where "collapse" of the membrane has occurred, and it has accordingly fallen inwards towards the opposite wall of the tympanum, the Eustachian tube has been obstructed or altogether occluded. In such instances, no external application will be of any avail; but perseverance in treating (as will presently be described) the impervious Eustachian tube and contracted tympanic cavity which have caused the "collapse," will often be followed by recovery of hearing.

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* This is not to be confounded with an appliance similarly named, which consists of a piece of gutta-percha tissue, harsh and often irritating, mounted on a stalk, and advertised by certain quacks as a great modern invention for the cure of deafness, which is utterly worthless and injurious to the ear.

The management of otorrhœa and other discharges from the surface of the membrane and from the auditory canal, which occasionally attend chronic catarrhal inflammation, will be detailed under that head.

Before proceeding to lay down rules for the local treatment which appears to me indispensable for the relief of deafness depending upon obstruction of the Eustachian tube and cavity of the tympanum, I will give a translation from Politzer's admirable treatise,* giving a brief abstract of "The Treatment of Chronic Catarrh of the Middle Ear and Eustachian Tube, without Perforation of the Membrana Tympani." You will thus be acquainted with the mode considered as the most effectual by the aural surgeons of Germany.

"After first inspecting the meatus and membrane we determine the hearing distance, both for the watch and the voice, and then proceed to the examination of the Eustachian tube, forcing air through it into the cavity of the tympanum in the way before specified (Politzer's new method), or by the catheter, and determining by means of the otoscope whether a current of air enters the cavity. When the hearing distance is hereupon noticeably increased,—an inch or a foot for the watch, and several feet or fathoms for the voice,—and we may infer therefrom the existence of swelling and excessive secretion from the mucous membrane of the tympanum and Eustachian tube, an injection of a solution of zinc into the middle ear is indicated, besides the employment of the 'new method.'"

"From four to eight grains of the sulphate to the ounce of water may be used. The catheter is introduced into the Eustachian tube, and held with the left hand. Some of the astringent solution is put into it by means of a little glass tube, and is blown into the tympanum by compressing with the right hand an elastic bag attached to the catheter. These injections should generally be repeated every third day, and continued for from three to five weeks. If, as in many chronic cases, no complete recovery, but only more or less marked improvement, takes place; the injections, after some months' interval, should be renewed for two or three weeks, to prevent, if possible, the further increase of deafness."

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* On "The Membrana Tympani in Health and Disease." American edition. By Drs. Mathewson and Newton. 1869.

"If, on the other hand, there is little or no increase in the hearing distance, after repeated employment of the air-douche, we may infer that the deafness is caused by the sequelæ of the catarrhal affection, viz., thickening of the mucous membrane and of the covering of the ossicula, with rigidity and diminished mobility of them, we can only expect improvement from the use of moderately stimulating injections, together with the air-douche. The following solutions seem best suited for injection :—Ammoniæ hydrochlor: gr. xx.; potassii iodid: gr. x.; sodii chloridi: gr. v. to the ounce of distilled water. After the employment of these injections from two to four times a week, in the way before described, we shall in some cases obtain essential improvement in the hearing; in others, the improvement is only slight, but we shall occasionally overcome, at least, the tinnitus, vertigo, and confusion in the head, which are symptoms accompanying chronic thickening of the mucous membrane of the middle ear. The improvement obtained by these saline injections in the cases supposed, seldom continues, since the thickened tissue of the mucous membrane, which was somewhat softened by the air-douche and the stimulating injections, has, like cicatricial tissue, a tendency to retract, whereby the rigidity of the ossicles returns. It is necessary, therefore, to repeat the injections and air-douche from time to time (for instance, every three to six months), every other day for a fortnight or month. The introduction of elastic bougies into the Eustachian tube is sometimes attended with essential improvement. We must remark that it is of especial importance to remember that a constant or too protracted employment of these irritating injections is injurious, while a treatment interrupted by pauses of weeks or months proves most effective."

This line of treatment, adopted I believe, by one English aural surgeon and by most of those on the Continent, is in my opinion too violent in character, and too abruptly entered upon. My own experience is opposed to the sudden and early introduction of the catheter, either as being necessary to diagnosis, or as a therapeutic agent. I would advise resorting to gentler and less disagreeable or painful modes of opening the Eustachian tube, and restoring air to the drum cavity; neither can I approve of the sudden and forcible injection of fluids. In a certain class of cases which have been brought to me, in which this mistaken treatment has been pursued, the hearing was very disastrously affected, and in one instance, not recoverable even to its former standard.

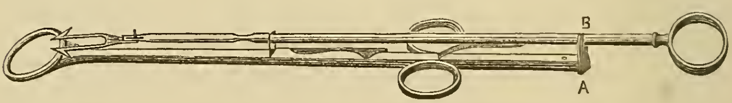
In *Obstruction of the Eustachian tube,* whether this condition arise from thickening, relaxation, or any other morbid condition of the faucial mucous membrane, or from disease proceeding outwards from within the tympanum, our first efforts must be directed to restore the perviousness of the canal. Place the otoscope in the patient's ear, and direct him to endeavor to blow air into the drum, by holding the nose, shutting the mouth, and making a forced expiration (the Valsalva method). This manœuvre need not be many times resorted to, for if, after a few attempts, it prove ineffectual, as it sometimes is with young children, and even some grown persons, from their sheer inability to understand the process, recourse should be had to Politzer's beautifully simple and most valuable invention. Children do not cry, nor do "nervous" ladies become frightened at this form of inflation, for it is not only painless, but neither uncomfortable nor alarming in its application. Its results are in many cases at once successful and astonishing to the patient.

If air cannot, by the gentle means specified, be passed into the tympanum, a careful diagnosis of the physical cause of the impediment should be made, and if it is ascertained to be due to a thickened, relaxed, or generally diseased condition of the mucous membrane of the throat, nose, pharynx, &c., which has continued itself into the faucial end of the tube (a frequent source of Eustachian obstruction), both local and constitutional remedies should be adopted before resorting to the catheter. Enlarged tonsils, nasal polypi, adenoid growths, &c., all of which have been previously specified as likely to co-exist with occlusion of the tube, and to act as predisposing, if not exciting causes of obstruction, must be treated at the commencement.

If the tonsils be very large, granular, hypertrophied, subject to small but recurring abscesses, and in consequence of their size, press the soft palate out of position, so as to restrict the proper action of the throat muscles which open the tube, I advise to excise them without delay; I mean by this that such portions as project beyond the palatine arches should be removed—not the whole gland, for that which remains after excision will contract and shrink up. Even if the enlarged tonsils have not yet injuriously affected the hearing in the indirect ways before specified, their removal is desirable, on the ground that they seriously interfere with respiration, deglutition, and speech; they likewise damage the general health, and retard the development of the the chest.

Local applications to the enlarged tonsils are often recommended, and too constantly adopted. Nitrate of silver rubbed over their surface, or points run into the substance of the glands; sometimes nitric acid carefully applied to portions of it; stimulating gargles, and a variety of useless and troublesome applications, have had their advocates for the arrest or removal of the masses, but it appears to the author a useless waste of time and material to attempt to procure absorption of such dense tissues. If constitutional treatment does not arrest, and local treatment be necessary, removal by the tonsilotome of a portion of the gland is the speediest and, in our opinion, the only efficient remedy. The surgeon with this instrument can remove all that is necessary in a few seconds, and the patient will be rid of the consequences in less than a week afterwards. Sometimes it is necessary to cut off an elongated and hypertrophied uvula.

FIG. 25.



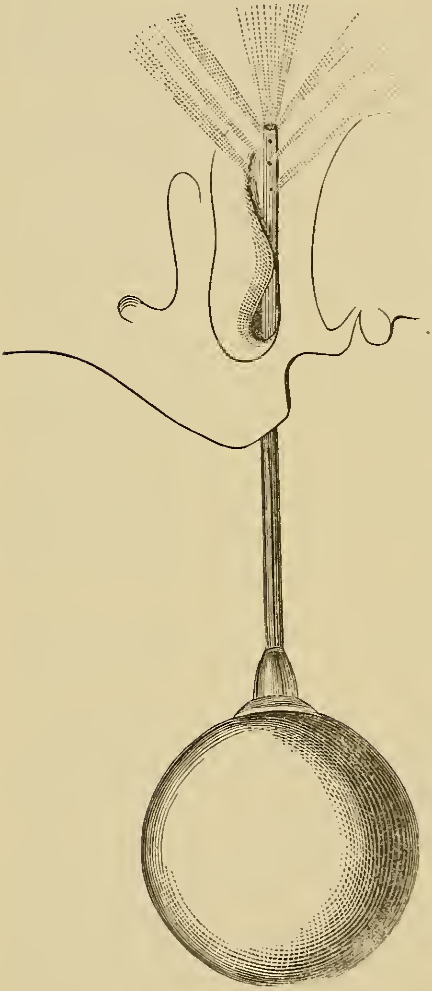
MATHIEU'S TONSILOTOME.

Local remedies to the throat are now to be considered. We must never neglect to treat the mucous membrane of the fauces by special applications, for it is possible that by such means we may succeed in reducing the thickening or granular condition, so as to allow the tube-muscles to resume their function; when on the tube being opened the deafness will suddenly disappear, with a "pop" or a "crack" as patients say. Such a desirable event must not, however, be generally expected. It must be looked upon as fortunate should the local remedies be successful in removing the granulations or other outgrowths, and in so far modifying the thickened or diseased condition of the mucous membrane surrounding the tube, that on a repetition of the "inflating" process, the obstruction shall yield. For getting rid of the adenoid vegetations, we may perhaps find it necessary to adopt operative measures, which will consist in crushing or scraping them off by appropriate instruments: or should they be very soft and small in structure, by *cauterisation* with the solid nitrate of silver. All kinds of granulations and condensed mucous structure are best treated with caustic, either in the solid form or a strong solution, from gr. 20 to 60 to an ounce of water. Use Toynbee's or similar caustic holders, which will allow of the bent end being passed behind the arches of the palate, so that the caustic may touch the orifice of the Eustachian tube. It is never necessary to introduce this agent through the catheter, as is recommended by some high German authorities who appear determined to poke that instrument into the nostrils upon the slightest possible excuses.

In almost all abnormal states of the throat, causing congestive swelling of the parts in the neighbourhood of the Eustachian tube, solutions of nitrate of silver are undoubtedly the most efficient local applications, and they are those best borne by the patient. It is not too trivial to mention here that bent whalebone with a piece of sponge attached, or a large camel's-hair brush turned at an angle, are not the appliances best adapted for touching the faucial openings of the tubes. In using them, the fluid is wasted on the front surfaces of the soft palate, instead of reaching the pharyngeal space behind. I always use a strong silver spatula, curved at the thin flattened end, round which I wrap absorbent cotton thoroughly saturated with a solution of nitrate of silver (40 grains to the ounce). Perchloride of iron, diluted with glycerine, may sometimes be substituted for the caustic lotion, or powdered alum, blown through a bent tube into the space behind the tonsils, is a useful astringent.

I am in the habit of recommending an elastic bottle and tube for the purpose of washing the nostrils, fauces, &c., which can either be introduced through the nostrils, or when curved at the end, passed into the mouth so as to inject the lotion in the form of spray against any affected parts. Vitiated mucous secretion can by this means be daily washed away by the patient, and the lotion will be brought into contact with the secreting surfaces. The effect produced upon the nasal and faucial passages is much more satisfactory than by gargling. This appliance seems peculiarly adapted for the cases of children, who do not, in general, easily learn to gargle. By combining with the injections carbolic acid solutions, or Condy's fluid properly diluted, the fœtid odour of the breath which so often attends these troublesome collections of vitiated stringy mucus will be lessened, if not wholly prevented. Astringent, alkaline, iodine, absorbent, sedative, or any other kinds of lotions may be employed through this instrument. (*Vide* engraving.)

Fig. 26.



Allen's nasal spray.

If all the means just described have been tried in vain, and the Eustachian tube remains obstinately impervious to air, we are compelled to have recourse to the catheter.

A pervious state of the Eustachian tubes is absolutely essential to perfect audition, even when the rest of the middle ear is apparently free from catarrhal disease.

When the Eustachian tube is rendered impervious by dense stricture, by fibrinous effusion uniting its walls, or by very inspissated mucus, the patient should not, in my opinion, be made to endure exploring by bougies passed through the catheter, unless there is very strong evidence to prove that the deafness certainly arises from the occlusion of the tube, and not from either tympanic or nerve disease. Should every means of inflation fail, it may be necessary to dilate the tube mechanically; but such an operation is very seldom really required. Mischief has of late years often resulted from the practice of attempts to pass stilettes, whalebone, catgut and laminaria bougies into the Eustachian tube. I have, in several instances, been perfectly successful in attaining the desired object simply by perseverance in using the local applications before indicated, and by forcing air *into* the tube by catheterism.

Where the deafness is occasioned by a *chronic catarrh of the tympanic cavity*, and the Eustachian tubes are quite pervious, the first point is to determine as precisely as possible the exact nature of the lesions. One of the most frequent causes of deafness, especially in children and young persons, is a *collection of mucus or other extraneous matter* within the cavity of the drum. Means must be adopted for causing its absorption, or removal by the air-douche, and perhaps by fluid injections. Good management of the general health, and appropriate local treatment, will in most instances, cause these accumulations to disappear. With the object of correcting the altered condition of the tympanic cavity, and of securing quite a free passage of air to it, the air-douche is most useful. Politzer's method, with the modified bag and apparatus which have been so often referred to, may be sufficient for the purpose. A mechanical pressure will in this way be brought to bear upon those parts of the tympanum which are elastic,—the membrana tympani and the fenestræ. This distension will have a tendency to relax these parts, and at the same time may counteract incipient rigidity of them and of the ossicles, and will loosen any recently-formed adhesions between these and the walls of the tympanum. When the Eustachian tube has once been rendered, by these means, completely patent, it is well to advise the patient to maintain it so by practising the Valsalva method of inflation at least once a day. If children, in whom there is often merely a tubal obstruction with a little hypersecretion of mucus in the tympanum, can be taught to keep the passage free to the middle ear by this simple action of holding the nose and blowing air into the drum, nothing more is necessary for removing their recurring deafness at every catarrh; and in adults the improvement or recovery of hearing is generally maintained by the process. If they cannot manage it themselves, direct their attendance occasionally for treatment by the inflating bag.

When the too great secretion within the tympanum is not removed by the air-douche alone, administered with the bag, warm vapours suitably medicated should be injected into the cavity. In most cases which are of some months' or years' duration, the thickened, swollen, and over-secreting lining membrane of the drum requires to be decidedly acted upon; and I find moist vapour (with which I sometimes mix acetic ether) to be the most efficient agent in softening the rigid hypertrophied tissues; and also in assisting the absorption of the effused fluid. Other vapours, such as those from iodine, carbonate or hydrochlorate of ammonia; chloric ether, henbane, conium and other sedatives, may be cautiously used, but the effects of many of these can only be ascertained after several administrations. If one kind does not succeed, another may. I have employed these and other similar vapours with varying success in the treatment of chronic catarrh, but my experience nearly agrees with that of Dr. Von Tröltsch, that with the exception of iodine and acetic ether, the vapour of hot water—*i. e.*, simply steaming the cavity of the tympanum, is the best. I would myself leave out iodine, for I have observed that its tendency is to irritate too severely all the mucous membranes with which it comes in contact. The injection of any of these vapours, except the irritating ones, causes in general no pain; but when the cavity has become diminished in size, from the congestive swelling, deposits, adhesions, &c., the mechanical distension of some parts and the breaking up of adhesive bands will cause a biting or aching pain, not however, of long duration. The treatment should be steadily continued—for many days—and many cases which have been considered beyond remedy will become immensely relieved or even cured.

Where accumulated mucus has become dried and very tenacious, the operation of incision or paracentesis of the membrana tympani, has again been advocated, to be followed by blowing the retained secretion into the meatus with the Politzer bag, or washing it out by the injection of various alkaline solutions through the catheter. It is the practice of Mr. Hinton "to syringe a strong solution of soda through the tympanum by the meatus, on each of the four days subsequent to the incision, if no irritation arises."

*"In the supplement which Dr. Millingen wrote to Dr. Adam Politzer's work on the membrana tympani, in describing the practice of the last-named surgeon in cases of accumulations in the tympanic cavity, and their immediate dispersion by the air-douche, he says 'Secretion is not always so fluid that it can be thus easily removed from the tympanic cavity, for when it has been retained for a long time, a gelatinous viscid matter is formed. This will either be absorbed in course of time or removed by the employment of Politzer's air-douche or by the catheter.

'In such cases, when the membrane was much shrunk and presented a dark greenish-yellow color, Dr. Politzer, after using the air-douche with only temporary success, performed paracentesis, and immediately afterwards forced air through the ear by his method, thus driving the mucous matter out into the external meatus. The opening in the membrane usually closed by the following day, and the hearing, moreover, was restored to its normal standard or returned after several applications of the air-douche.'

During the last few years this plan of treatment has been employed in England with varied success, in some instance with very considerable advantage. An account of it, with cases, was published by Mr. Hinton in the "Guy's Hospital Reports" for 1869 and 1870. While light is reflected down the speculum from a mirror fastened on the forehead of the operator, a vertical incision, about one-eighth of an inch in length, is made either in front or behind

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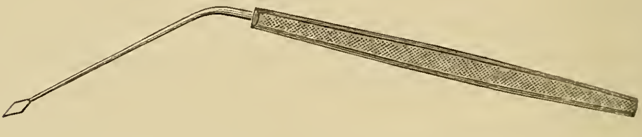
* Dalby on Diseases and Injuries of the Ear, page 97.

the handle of the malleus with a small double-edged knife made for the purpose. If expulsion of the mucus does not follow the passage of air through the cut on Politzer's plan, a weak solution of soda, or simply warm water, may be passed through the incision by means of a syringe the nozzle of which fits the meatus (it is carefully protected by a rim of india-rubber), the fluid passing through the tympanum and Eustachian tube out at the inferior nares as the head of the patient is bent downwards. In this way any accumulation of mucus in the tympanum is dislodged from its situation. The opening made in the membrane is thus merely the preliminary step of the proceeding, and is simply a means to an end, so is in no way a revival of the operation practiced by Sir Astley Cooper for the relief of Eustachian obstruction and the troublesome symptom of tinnitus. This at the best could only give very temporary benefit, as an incision in the tympanic membrane heals in from two to five days.

Fig. 27.



Politzer's knife for making incision in the tympanic membrane.

You will observe, too, that the object of the incision in these cases is very different from that had in view when it is made in the course of purulent catarrh of the middle ear: in the latter instance it is done to provide an outlet for the pus which fills the cavity of the tympanum, and which, unless let out in this manner, causes rupture of the membrane and more or less disorganization of the contents of the tympanum.

At the same time there is no doubt but that in the unpurulent variety of catarrh of the tympanum, when the secretion is very copious, the membrane will sometimes give way in consequence of pressure, and thus an opportune incision will prevent ulceration taking place. This, however, is not the principal or only object in adopting this practice."

*"A certain proportion of the cases in which it has been done have unquestionably obtained improved hearing in consequence, whilst others have been no better afterwards, and in no cases that have fallen under my observation has the hearing been disimproved by it. If this can be shown to be the experience of all who have practiced this operation there are certainly quite sufficient data to make the proceeding advisable under appropriate circumstances. Now, what are these circumstances?

Unfortunately, it is rare to meet with appearances in the tympanic membrane of so distinct a character as to enable us to say with certainty, 'There is within that tympanum the remains of catarrh in the form of semi-fluid accumulations of mucus, which can be removed after an incision has been made into the membrane.' Such appearances are described, in the report referred to, as spots of a brownish-yellowish color due to dark-colored fluid in contact with the inner surface, bulgings of the membrane in places, especially at the posterior and superior part, and thinned spots which can be made to bulge on inflating the tympanum.

You will find that in cases where these changes are noticeable the same history is given as in others where there is no more abnormality to be seen than a somewhat exaggerated inward curvature, or a general opacity, which is merely indicative of previous attacks of catarrh. Hence the difficulty in deciding the question as to whether the opening should be made in the membrane or not. The most reliable sign, I believe, which we possess of the presence of fluid mucus in the cavity of the tympanum is the sound which accompanies inflation and is heard through the otoscope. Occasionally, upon the patient's pressing air into the tympanum there is a squeaking and bubbling sound most characteristic of the condition under notice. It is with such cases that I have never failed to obtain good results after this operation.

My own observations and experience, therefore, go to show that the cases favorable for this treatment are not necessarily either those in which the catarrh is recent or cases of very long standing, but that the condition of the tympanum which I spoke of as a dry condition must not have been reached.

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* Allen.

Useful as this operation undoubtedly is in favorable instances, I need, perhaps, hardly say that it is a sufficiently serious one to make it necessary to exercise great care and judgment in the selection of cases, and it should not be resorted to until less severe measures have had a fair trial. In coming to a decision on this question the occurrence of any of those symptoms which point to a lesion of the labyrinth (which will be detailed in a future lecture) would contra-indicate the operation."

Dr. Schwartze, who first brought the practice of incision into its renewed vogue, advises it "in certain cases of acute inflammation of the membrana tympani, where in a very short time a great swelling occurs, chiefly and greatest in the posterior and upper quadrant, and when in spite of other remedies there is a very obstinate and severe pain. It quiets the pain, and thus shortens the course of the affection." In this description you cannot help recognizing the earlier stage of otitis; or, as I term it, *purulent catarrh.* But Schwartze himself decidedly disapproves of incision where there is simply tenacious mucus in the cavity of the tympanum, because he fears that the small collections are never evacuated through the opening, and that "very severe reaction often occurs in such cases after the paracentesis, active inflammation which terminates in suppuration, and often with considerable diminution in the acuteness of hearing." Von Tröltsch, in speaking of incision being performed in cases of *chronic catarrh,* says, "Among the many reports of favourable results from this operation, none of them could be said to give any sufficient evidence of its real value; and I must, therefore, fully coincide with Schwartze, when he says that 'up to the present time it is only in very rare cases that a permanent success has been seen by trustworthy observers.*'"

Where the mucus has become dried and hardened in the tympanum, impeding the passage of sound, and setting up adhesive processes which may at a later period act most disastrously upon the hearing, no time must be lost in endeavouring to modify so formidable a condition. I believe it is frequently these cases which are set down as "nervous deafness," "thickening of the drum," "anchylosis of the stapes," "rigidity of mucous membrane," "bands of adhesion," &c , &c. Improvement is generally effected with ease, by injecting through the catheter weak alkaline solutions, which will first soften, and then dissolve the hardened masses. Afterwards, when sufficiently thinned, and rendered less irritating and clogging, the altered secretion may be treated in the same manner as above recommended for simple mucous accumulation. As solvents, I usually employ injections of the bicarbonates of potash or of soda, or iodide of potassium, and afterwards as an astringent, sulphate of zinc (gr. ij.—v. ad. ʒ j.). It is well to suspend this treatment for a few days, and employ only the air-douche with steaming. The lotions may either be placed in the nostrils by a syringe, and then blown into the tympanum with the Politzer bag, or if not objected to, the catheter may be made use of for the purpose. For very chronic cases, and where the patient is unable to give regular attendance, Dr. Gruber of Vienna has pointed out a simple method by which the patient can himself introduce fluids into the tympanum. "Inclining his head well to the affected side, he puts into the nostril on the same side a glass or elastic syringe, containing about ʒ ij. of the required solution. This he syringes firmly into the pharynx, where it lies in contact with the orifice of the tube. He then quietly, and without swallowing, inflates the tympanum."

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* The reader may probably have heard of, or even have seen paracentesis abdominas performed when the real ailment, or rather condition, was one *more natural and less alarming* than either ascites or ovarian dropsy. Such a mistaken operation was called by Sir Astley Cooper, "dry tapping!" If statements may be relied upon, paracentesis membranæ tympani has, on some occasions, likewise proved "dry."

Counter-irritation, by painting Lin : Iodi, on the mastoid process behind the ear, is very useful in treating chronic catarrh of the tympanum, especially when there is reason to believe that the mastoid cells are partially clogged.

The *constitutional treatment* of chronic aural catarrh can be considered only as auxiliary to the local, yet much stress should be laid upon the necessity of exercise, bracing air, warm clothing, &c., and upon the taking such medicines as impart tone to the system. In children particularly, who suffer from a generally disordered state of the throat, languid circulation, and consequent deficiency in nervous energy, great attention should also be paid to the skin, and to proper diet.

In cold weather warm baths are advisable, taken in the house, not out of it: in summer, cold—especially sea—baths, and vigorous friction with rough towels afterwards, so as to produce a ruddy glow. Plunging the head in cold water, as boys so frequently do after exercise, &c., is objectionable. I have known severe catarrh to be induced by this practice, and bad cases of thickening to result from it, of course causing deafness. Youths should not be overworked mentally, and early hours for retiring to bed ought to be insisted upon. Sleeping-rooms should be well ventilated, and all general hygienic rules strictly observed. Cod-liver oil, various preparations of iron sometimes combined with alteratives, mineral acids, vegetable bitters, iodide and bromide of potassium, will all be found useful by turns.

OTITIS.

ACUTE inflammation of the middle ear is one of the most painful of all ailments, and is more commonly met with in children than in adults.

CAUSES.—If the inflammation be not an accompaniment of one of the exanthematous disorders, the exciting cause will generally be "having taken cold," or exposure to draughts of piercing wind.

SYMPTOMS.—A sudden paroxysm of pain awakes the child in night or towards morning out of its sleep, and a violent fit of screaming, sometimes attended by convulsions, follows. Days and nights are passed in extreme anguish ; the tongue is dry and furred, pulse hard and very rapid, skin dry, bowels constipated ; considerable fever is also present. The cry of the child is almost unearthly. Even strong men afflicted with this disease often utter cries or moans of a piercing character ; and the pain is usually described by them as severe and agonizing. The suffering seldom remits for any length of time, and the child's sleep is suddenly broken by paroxysms of darting pain through the head and in the ear. Convulsions may now set in for the first time, or may recur more often, the sharp cries of agony are succeeded by hoarseness, low moaning, and exhaustion. More decided head symptoms, indicative of an extension of disease to the brain or its membranes, succeed this terrible struggle; then coma ; and death will presently close the scene of suffering.

DIAGNOSIS.—It is well to note the circumstances which will help to distinguish this affection, in a child, from some other less severe infantile ailments. The loudness and shrillness of the screaming will show that neither the lungs, trachea, nor other portions of the respiratory apparatus are greatly implicated ; because in affections of those organs children never cry loud or continuously.

The cry more resembles that uttered by a child suffering from inflammation of the bowels, or a primary affection of the brain, but the other symptoms indicative of such disease will be absent from these cases. The circumstances under which the pain appears to be increased or mitigated, and how, should be carefully noted; for owing to the inability of children to designate the situation of their pain, and the difficulties always in the way of making a sufficient examination, we have to attend to every minute particular if we care to make our diagnosis really certain. When the middle ear is the seat of disease, the pain will be increased by every rough movement of the body; the child will cry more and more every time it is "jumped" in the arms of the nurse, or in any way violently shaken; changes in the position of the head call forth renewed expressions of pain, and if only one ear be affected, the screams will be more distressing when the child is laid on that side; any loud noises disturb; cold air and draughts, and also bright light, are shrunk from; and every effort at swallowing, sneezing, coughing, and the usual accompaniments of a common cold in the head will all aggravate the pain. If being suckled, the infant will move itself away from the breast, or push aside the bottle after a few attempts to suck, while its usual nourishment will be taken somewhat more easily administered with a spoon. Warm water poured frequently into the ear, hot soft applications, gentle bathing or steaming, and perfect quiet, will always soothe the pain. In other disorders with which this affection might on a mere cursory examination be confounded, none of the above-named actions or personal movements would have the effect of aggravating the pain, nor would the palliatives mentioned give sensible relief. Otitis in the youth or adult is attended by symptoms of like character to those just described as occurring in the infant; but for obvious reasons it will not be so difficult of recognition. It need scarcely be said that the consequence, whether in a child or grown person, is always impairment of hearing, and sometimes total deafness ensues.

The objective appearances, or *local* symptoms in the ear, are likewise at their commencement very similar to those of a severe case of simple acute catarrh (page 144). The inflammatory action having commenced from within the tympanic cavity, the membrana tympani will not at first have lost its transparency; and the congested thickened mucous membrane, with its distended blood-vessels, may be at the beginning distinctly seen through the drum-head. In other instances, opaque fluid may be distinguished, lying within the cavity. As the disease makes progress, the membrana tympani becomes flatter and duller, darkish red in colour, and streaked with blood-vessels on the outside. The collection of pus behind presently bulges it outwards; its external surface has a sodden look, and it is sometimes so covered with macerated epithelial scales which have peeled off from the swollen and thickened lining of the external auditory passage, that it can scarcely be seen at all. The auricle itself, especially about the tragus and concha, participates in the inflammatory action, and is œdematous, swelled, and shining, or occasionally of a livid colour, hot, and tender to the touch. In later stages of the disease, when it has continued for some days, the skin over the mastoid process also becomes reddened and tumefied, and painful when pressed upon. This swelling behind the ear is serious in character, and dangerous if not properly attended to. It therefore requires to be examined with great care; and considerable but cautious pressure must be made with two fingers upon the soft swollen and œdematous integument, in order to detect, by the degree of fluctuation, or "pitting," the possible presence of matter, which may be deeply seated beneath the fascia. If the patient's throat be looked into, the pharyngeal and faucial mucous membrane will appear swelled, congested, or granular, and the Eustachian tubes are probably rendered impervious by extension of the disease; the general condition of the throat resembling that observed in scarlatinal inflammation.

Some very exceptional cases do now and then occur, where an abscess in the tympanic cavity forms so very gradually, that it will run its course and cause a perforation of the membrana tympani without producing severe pain or any great constitutional disturbance.

This ailment may terminate in *resolution*, in which the pain gradually subsides, the swelling lessens and the hearing is restored, although tinnitus may continue for some time. The most common termination is, that the matter bursts suddenly through the drum-head and is discharged; *otorrhœa* is thus established. Often, however, the termination is more serious, by extension of the inflammatory process to the brain and its membranes, and thus ending fatally.

TREATMENT.—The treatment of this affection should be conducted with energy and great care, not only to mitigate suffering, but also to guard against the diseases involving the deeper and harder tissues, and thus extending to the brain and ending fatally.

The patient must be kept in a warm and well-ventilated room, and, if the symptoms are threatening, should be confined to bed. Leeches must be applied as often and in such number as the urgency of the attack requires, and having regard to the general condition of the patient, as they, of all means employed in the treatment of this painful and threatening disease, will be found most effectual in immediately affording relief to and mitigating the sufferings of the patient.

The application of poultices, or better still, absorbent cotton soaked in hot water and applied to the parts as warm as it can well be borne, and frequently repeated, will be found useful. Filling the ear with warm water or warm water medicated with opium will be found grateful to the feelings of the patient. The vapour of very hot water directed to the fauces gives much comfort.

The general treatment must not be overlooked. The bowels should be freely acted upon. The skin being generally hot and dry, diaphoretics combined with sedatives are required in the early stages. Warm foot baths or baths for the whole body, will be found valuable aids in allaying the inflammatory fever.

The diet must be light. Animal food must be abstained from.

When there is a bulging outwards of the drum-head and we are assured by other objective symptoms that pus has accumulated in the cavity (especially if there be delirium, convulsions, or any other alarming signs of cerebral irritation), incision or puncture of the membrane ought to be performed without delay. This operation under these circumstances will be found to be immediately and strikingly beneficial in its results. The distressing pain is at once relieved, and the further tendency of the disease to the brain averted. This operation results in much less loss of structure to the drum membrane than when perforated through the process of suppuration and ulceration.

The mode of performing the incision of the membrana tympani is very simple and the operation easily performed if the patient is tractable. I use for the purpose Toynbee's tympanum perforator, (or Politzer's knife—see page 200,) either straight or angular, as I may find best adapted to the case.

The patient should be placed in a sitting posture, if a child it should be placed in a high chair with its head on a level with that of the surgeon's, who is seated. A speculum is then placed in the ear, while a good light is thrown to the bottom of the meatus from a concave mirror attached to the forehead of the surgeon, by means of a forehead band or handkerchief, thus leaving his both hands free. Some portion of the membrane will generally be observed to be more distended than the rest, or bulging outwards. *This spot*, wherever it may be, should always be selected for the incision. It will usually be near the middle or on one or the other side of the malleus, because at this part the fibrous laminæ being thinner, offer less resistance to the pressure or ulceration from within. The cut should extend down to the integument of the meatus so as to give all the accumulations free vent. If, in the course of this disease, the *mastoid process* has become tender to pressure, the skin over it red and tumefied, and particularly if there is any sense of fluctuation to be discerned, prompt measures are required to prevent caries of the bone, or mischief extending to the cranium and its contents, we must not hesitate to make an incision into the affected parts *down to the bone*. The periosteum must be fully divided, to liberate the pus confined beneath, and to relieve the painful tension. To avoid the posterior auricular artery, the cut should be made from half to three-quarters of an inch behind the auricle, but parallel with it. After incision poultices should be applied. If dead bone be there it will come away with the discharges, if not it should be removed. If there be no dead bone the wound will shortly heal.

Such promptness in dealing with mastoidal abscess is imperatively demanded. The disease is highly dangerous, and, if recourse is not had to incision, generally fatal. If the pus, in consequence of its deep situation in the cells, has not been reached, and signs of cerebral irritation, such as giddiness, vomiting, pains in the head,

&c., are still persistent, the mastoid process must be opened with the trephine, in order that the pus may be evacuated.

The treatment of perforation of the drum-head in purulent aural catarrh should be mainly directed towards getting rid of the suppurative inflammation. Thorough removal of the secretion, by careful syringing with warm water, is essentially necessary, and should be done two or three times a day. If the cavity is much exposed, a little soda may be added to the water. The syringe should be very small, yet with all precaution and gentleness we can bring to bear, in syringing, vertigo, fainting, or sickness will sometimes ensue, especially if the water is not of a proper temperature. It should be tepid only, never hot nor cold. If the perforation is small, removal of the morbid secretion cannot be perfectly effected by injections through the meatus, for in these cases doubtless the air spaces in the mastoid cells as well as the recesses in the tympanum are crammed with it. An attempt should therefore be made by the patient to dislodge or force the accumulations from within outwards by simply practicing the Valsalva method of inflation before syringing is commenced. When this cannot be effected the Politzer bag should be used, after which masses of morbid secretion may sometimes be soon extruded from the cavity into the meatus. Perforation should not be healed over or closed so long as any internal otitis or suppurative inflammation continues.

OTORRHŒA.

CHRONIC suppuration of the middle ear, commonly called "running ear," is a very common affection of an extremely loathsome character. It is, properly speaking, only a *symptom* of certain diseases of this organ, as of inflammation, ulceration, polypus, granulations, &c., *sequelæ* of some previous disease, such as scarlet fever, measles, or any of the exanthemata, or catarrh or "cold in the head," or it may result from mechanical injury. It occurs sometimes in young children without any known cause. It is an affection of much gravity and should *always* receive prompt and careful attention and treatment from its first appearance, until every vestige of the disease producing it is eradicated, otherwise it will prove a life-long affliction, depriving the patient of his hearing, thereby unfitting him for the duties of life, placing him to every disadvantage incident to the loss of this most important sense, and depriving him of every pleasure it affords; sadder still is the fact that good health is seldom or *never* enjoyed by those who are afflicted with this ailment any length of time. All suffer from blood-poisoning and its evil tendencies, while life itself is in imminent peril. Added to this is the loathsomeness of the disease, which is not only offensive to the afflicted, but equally or more so to those about him, thus debarring him from society. Sad indeed is the contemplation of such a state of existence, but sadder far is its realization, and yet in spite of all these facts it is quite common for people (the laity), and even with some physicians, to treat this affection with supreme indifference and neglect, some even regarding the condition rather as physiological than pathological. There can be no excuse for such criminal ignorance or willful stupidity on the part of such professional men.

When I state the fact that my experience in the treatment of this affection is quite large, amounting to some thousand cases during the past year, nearly all telling the same sad story of neglect and indifference on the part of physician and friends, it may be granted I should be accorded a hearing on this subject, but I desire that others more eminent than myself shall bear testimony to at least some of the facts above stated, and to that end I quote as follows:

*"I propose, therefore, to demonstrate that the subject is one of great importance in the prognosis of the probabilities of a life being 'good,' and to suggest that, in a doubtful case, the verdict should be held in abeyance until the suspected ear has been carefully examined and tested. I can well imagine the medical referee objecting to make a tedious examination with aural speculum and other tests, in addition to his multifarious professional and secretarial duties, for the ordinary fee of a guinea, or in some cases, for as little as half a guinea; yet the subject is of the greatest importance both to the office (Life Insurance) and to the proposer.

The causes of chronic suppuration of the middle ear are acute and subacute catarrhal inflammation, and acute suppurative inflammation of the tympanum, which may result from small-pox, scarlet fever, measles, typhus, diphtheria, pneumonia, ordinary catarrh, the gouty, scrofulous, or syphilitic dyscrasiæ, and occasionally mechanical injuries; the results are polypi and exostoses, disease of the mastoid cells, caries and necrosis, meningitis, cerebral and cerebellar abscess, pyæmia, phlebitis, and paralysis, or even *possibly*, insanity.†

Several medical *confreres* connected with Insurance companies, with whom I have discussed this matter, have observed, that one would be sure to find out the discharge, without putting a direct question, as otorrhœa is only a manifestation of an obviously scrofulous constitution, or that the resulting deafness would betray the patient. Such is not practically the case, as numberless cases of otorrhœa occur in otherwise perfectly healthy subjects, the result of fevers, catarrh, &c., occurring in early childhood: and a patient may have very good hearing with perforations in both drum-heads, and in fact is himself often quite unaware or oblivious of his defect; on the other hand, one ear may be perfectly sound and the other extensively diseased.

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* Llewelyn Thomas, M. D., Essays on Ear and Throat Diseases, 1878, page 32.

† Since first publishing this article, the following very interesting case has been related in the Lancet.

"C. D. C., age 26, no insane relations—13 days before admission into Bethlem Asylum, became rambling and violent; after admission was sometimes sullen sometimes excited; 9 months after admission, it was noticed that he had a profuse discharge from the left ear, which he said had been there for months past; hearing was unaffected apparently; ultimately a swelling formed over the mastoid, the patient was now too sullen and dangerous to examine. On the 10th month after admission, 'the abscess was opened under Ether Spray, and he became sane at once,' and was very shortly discharged well."—LANCET *April 28th*, 1877, case reported *by* W. RHYS WILLIAMS, M. D., *resident Physician, Bethlem Royal Hospital.*

The late Mr. Toynbee* and Dr. Roosa,† the talented New York aurist, have published tables, the one containing the histories of nineteen, and the other of forty cases of fatal cerebral disease the result of tympanic affections; from these tables it may also be seen that death may occur from chronic aural disease at any age, and at any period, however remote from the commencement of the discharge. Mr. Toynbee cites a case, terminating fatally after the existence of otorrhœa for thirty-five years, and Dr. Roosa one after forty-one years. It is thus evident that chronic suppuration may lie dormant for years,‡ and may then be kindled into a most fatal disease, either by some accidental circumstance, as exposure to cold, an injury to the head, a deteriorated state of health, or more commonly by the mechanical results produced by the affection itself, and the neglect of a proper precautionary or curative treatment.

A careful consideration of the anatomy of the tympanum will at once show what a dangerous locality it is in which to have a chronic suppuration as a constant inhabitant; in fact, I am acquainted with no other region of the body which is in relation with such terribly vital parts. The roof of the tympanum is in contact with the meninges of the brain; the bone is here often thin and porous, or even entirely absent, so that the tympanum actually not infrequently forms a portion of the cavity of the cranium. This is a most significant anatomical fact, and one probably hardly sufficiently borne in mind.

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* "Diseases of the Ear," p. 345. London: Lewis. 1868.

† "Treatise on Diseases of the Ear," 2nd edition p. 452. New York: Wood. 1872.

‡ Since this article appeared in the *British Medical Journal*, Dr. W. J. Little has kindly sent me the following important opinion. "My London Hospital Physician experience early brought me in contact with the serious nature of chronic suppuration in the internal ear. At the Briton Life Office, I have always represented that no such case should be given a *probable viability, beyond the age of 35.*"

The floor of the tympanum is sometimes bony, sometimes membranous, and, lying lower than the floor of the external auditory meatus and the orifices of the mastoid cells and Eustachian tubes, is often the seat of purulent accumulations in suppuration of the middle ear, which may result in phlebitis of the jugular vein. The inner wall is the outer boundary of the labyrinth, and is in front of the promontory in contact with the carotid artery; caries in this situation may produce hæmorrhage from the carotid, or suppuration extending through the labyrinth into the cavity of the skull. The posterior wall opens into the mastoid cells, which are bounded internally by the lateral sinus—a consideration of importance in suppuration of the mastoid, or in attempts to remove polypi springing from this locality. Polypi and exostoses of the tympanum, produced by the irritation of the chronic suppuration, may both prove fatal, either by pressure and caries, or by blocking up the discharge and producing meningitis; the pus in these cases rarely finds its way through the Eustachian tubes, in opposition to what one would at first sight expect, as they are generally rendered impervious by the long continued inflammatory processes. The mastoid cells are generally more or less affected in a suppuration of the tympanum; but at any time a more dangerous affection may be lighted up; either acute periostitis or caries, from accumulation of the discharges, both of which frequently prove fatal from extension to the meninges, especially in cases where the gravity of the premonitory symptoms has not been early recognized and actively treated. Caries of *any portion* of the temporal bone may take place, and is always dangerous, as it not infrequently results in meningitis, abscess, hæmorrhage, or phlebitis. It is not at all easy to determine the existence of caries in many cases, as the probe cannot here be used with anything like the same degree of boldness as in other parts. If a suppuration persistently resist treatment, and especially if it be uniformly offensive to the smell, caries, however minute it may be, of some portion of the bone probably exists; caries even of the external meatus, from the proximity of the dura mater to the upper wall and of the mastoid cells, may produce meningitis. Pyæmia producing abscesses in other parts of the body also occurs, probably from the entrance of pus or the products of its decomposition into the circulation through the mastoid veins or lateral sinus.

One of the most interesting facts in connection with the subject of chronic aural disease is its connection with cerebral abscess; for, from the published cases of German and English authors, it appears that from one-third to one-half of the cases of abscess of the cerebrum arise from aural disease. This is readily understood, if we consider the intimate connection of the dura mater with the roof of the tympanum, and might be considered alone sufficient to invest the subject of otorrhœa with vital importance. There is usually meningitis in connection with the site of the abscess; but sometimes the membranes are healthy, and even a portion of healthy brain-substance may intervene between the temporal bone and the abscess. Collections of pus are also not at all uncommon in the cerebellum after chronic disease of the mastoid cells; and here occurs another possible source of error in prognosis; the discharge, when investigated, may appear to come from the meatus only, as the membrane, is seen to be intact, yet there may be in such case caries of some portion of the temporal bone and disease in the mastoid cells, *without perforation* of the drum-head. Such cases are rare, though they are on record. Apparently, no rule can be laid down regarding the danger of necrosis of the different portions of the temporal bone; in many cases, a fortunate hyperplasia takes place around the tympanum, and shuts it off from its perilous neighbours; the ossicula may be discharged, and even the cochlea and labyrinth, without any bad symptoms, beyond the loss of hearing, supervening.

If the perforation in the drum-head be small or blocked up by granulations requiring considerable force to blow air and the discharges through it, the prognosis is more unfavourable than in the case of a large perforation or entire destruction of the membrane, as it is probable that at some future time the exit of the matter will become impeded, with possibly serious results. I trust that the foregoing remarks have demonstrated the importance of investigating otorrhœa in connection with Life Assurance, and I would suggest that no life should be certified as first-class or even second-class in whom examination indicates a suspicion of caries or the existence or recent occurrence of anything like an inflammatory process.

It should be borne in mind by intending Proposers that any concealment, whether fraudulent or accidental, of any ailment existing at the time of the proposal, may seriously invalidate the value of the policy. Mr. John Messent, the well-known Actuary, writes me, that his office considers that 'a deduction should be made from the sum guaranteed by the policy, if it can be ascertained that the Proposer has had a discharge from the ear since childhood, and had it at the time of effecting the Assurance.'

Dr. Patterson Cassells, in a paper read before the Glasgow Medical Chirurgical Society, mentions a case of a gentleman with ear disease, who was called upon to resign a policy which he had held for ten years, on the ground that no mention was made in the *contract* of Assurance, that he had a discharge from the ear. He had the opportunity given to him to make a new proposal, which he did; but the Directors refused to accept the life on any terms. He was subsequently accepted by another office, with a loading of five years added to his age."

* "The fact that a running sore is detrimental to the continuance of good general health, would scarcely need assertion, were it not that the author, in common with many others, has observed a very deeply rooted idea among the laity—an idea that was first inculcated, and which is even now encouraged by the profession—that there is no harm resulting from a chronic ulcerative process in the ear, when it is well out of sight. It is even at times gravely asserted that such a drain to the system is salutary, as if our Creator would not have made the human race with such a one if it were necessary. I have seen persons who allow their ears to become an offence to the nostrils of those about them, because they have been advised by their physician that it was not best to 'meddle with the ear.' If my reader feels that I have said too much on this subject, in the different parts of this volume, I beg that he will ask himself how many cases of death he has known as the result of a suppurative process in the ear, to consult his fellow practitioners

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* St. John Roosa's Treatise on the Diseases of the Ear, page 369.

on the same point, and finally to investigate the statistical tables of deaf and dumb asylums. In the answers to these interrogatories will be found a complete justification of my earnestness on this point."

Dr. T. H. Tanner, of England, on this subject in his treatise on the Diseases of Infancy and Childhood says: It is commonly neglected, or treated with purgatives and any "drops" that the fancy of the nurse suggests: no proper examination is made: and a loathsome, obstinate discharge is established. Thus, that which might have been cured in a short period by appropriate treatment, is allowed to become a chronic affection; in which case it may continue for years, destroying in the course of time the membrana tympani, the ossicula auditus, and producing caries of the bony walls of the meatus and tympanum. The disease may even extend to the cells of the mastoid process of the temporal bone; or in the opposite direction along the petrous portion of the same bone, until the brain and its membranes becoming involved in the unhealthy action, rigors, fever, and masked cerebral symptoms show themselves, and the case ultimately terminates in convulsions, coma, and death.

Prof. Lebert of Germany has called attention to these common fatal results of inflammation of the ear caused by extending to the membranes and the brain or the lungs.

Prof. Von Tröltsch, Aural Surgeon and Lecturer in the University of Wurz-burg, Bavaria, says: "Diseases of the bones, in the parts affected, is a common result of this affection."

"Every discharge from the ear, under certain circumstances, leads to affections dangerous to life. When of long standing, inflammation of the brain substance and the formation of abscesses in it have been observed as the most common of the effects of this disease, directly or indirectly.

Prof. Wilde, an Aural Surgeon of eminence, says: "So long as we have a discharge from the ear, we are never able to say *how, where or when it will end.*"

Several English Life Insurance Companies refuse entirely to take risks on persons suffering from otorrhœa.

SYMPTOMS.—The most noticeable symptom of this affection is a discharge of pus from the ear. This may greatly vary in quantity and consistency, and may appear continuously or at intervals only, during either the day or night time, or it may only appear periodically, at intervals of a day, a week, a month or longer. It may be very profuse or so scant as scarcely to be noticeable, all indicating different pathological conditions of the parts from which the discharge emanates. In cases where the discharge takes place only at long intervals, patients often complain of pain and unpleasant secretions in the ear and there is at such times more or less heat and swelling of those parts. These symptoms generally come on after taking cold and subside after a discharge takes place. Patients thus affected will say they have "no running ear" but are "troubled with abscesses." If the ear be examined during the interval when the discharge is supposed to have ceased, there will be found in the bottom of the canal and in the cavity of the drum a hard and tough mass of dried pus and wax. Hardened or impacted cerumen is quite frequently found in connection with chronic suppuration of the middle ear, sometimes completely suppressing the discharge. I have frequently had cases of this kind where I only discovered after removing such accumulations that I had a case of chronic suppuration of the middle ear to deal with.

The membrana tympani or drum-head, in this affection will always be found on examination to be perforated—most generally entirely destroyed and with it the loss of the *malleus* and *incus,* and sometimes also the *stapes.* In other cases when a large portion of the drum-head remains these little bones are found in position. Most people have an idea when "the drum" is perforated the hearing is lost and cannot be restored. I have even met physicians who held such views. That is not the case. There may be small perforations of the drum-head and yet the hearing hardly perceptibly impaired; the entire drum-head may suppurate away and with it the *malleus* and *incus* may drop out and yet fair hearing may continue; usually, however, under these circumstances the hearing is much impaired and in some cases entirely and irretrievably lost. In my experience I have usually found the remaining hearing power in such cases to be from one to five or six inches by the watch test, in some more and in others less, but rarely entirely lost. The degree of deafness depends on the location of the inflammation or ulceration. If the fenestræ are much involved the hearing power is very limited and in many such cases entirely lost.

The general health of patients afflicted with long-standing otorrhœa or chronic suppuration of the middle ear is almost always affected; in some cases greatly so. I have met with one case of 30 years' standing, whose average or usual weight in health was 175 lbs., had by this ailment been reduced to 138 lbs., but who on being cured of this affection, in four months from the time he first came under my treatment regained his usual weight of 175 lbs., and ever since (several years) has continued in excellent health and whose hearing is also quite good.

Now, while on one side we find all just medical men whose experience in the treatment of this loathsome and dangerous disease has been great, and whose authority is worthy of most considerate regard, stand proclaiming its dangers and advocating in unmistakable language the great importance of timely and active treatment in this affection, that its progress may be staid and the life of the patient saved and his health and hearing restored; on the other side we find a prejudiced public, sustained by the misguided judgments of a class of inexperienced and sometimes careless physicians who have too long and too often proclaimed the harmlessness of this affection and against its treatment and thereby betrayed their trust.

Dr. Tanner says, "No mischief whatever can ensue from curing either recent or long-continued otorrhœa, as was at one time—and is still by the vulgar—feared."

Dr. Roosa says, in his treatise, on this subject, "There is, I believe, no pathological experience on record which can sustain the quite common assertion that it is dangerous to stop a discharge from the ear."

Prof. Von Tröltsch says: "You will still allow me a few words concerning the prejudice felt against the local treatment of 'running ear,' as having a bad effect upon the general health. I have *always* found the opposite to be true: that with a gradual diminution of the discharge the general health is improved, and that very many persons lose their lives because the discharge is allowed to go on." He further says: "I have learned that a sudden cessation of the discharge is *not* productive of evil results," and he intimates in the following language *why* so many physicians and surgeons seem prejudiced against arresting the discharge: "We will be very likely to regard each view of the surgeon or physician against the sudden stoppage of the discharge, as very like the idea of the fox in the fable when the grapes were beyond his reach."

The longer an otorrhœal discharge continues, the more offensive and disgusting will be the smell arising from it. "Some (says Wilde), may endeavor to conceal this affection, others are deterred from taking proper advice by the prejudices of their friends and even of their family medical attendants; they are afraid of the effects of healing or drying up the discharge from their ears."

"I, like Sir W. Wilde," says Prof. Allen of England, "have never been able to discover one well-authenticated instance when disease in the head has resulted as a consequence of checking otorrhœa, and we should by every means in our power endeavor to heal them."

Prof. S. D. Gross of Philadelphia, in his work on Surgery says, on the subject of the treatment of this disease: "Another mistake which is often committed is the belief that the malady (disease) upon which the discharge depends, will in time disappear spontaneously, or to use a more vulgar phrase, that the patient, especially if a child, will gradually outgrow it. Such an opinion is as absurd as it is culpable, and cannot be too severely censured. The poor patient, confiding in the judgment of his professional advisor, goes on from bad to worse, until awaking from his dream, he finds that his ear is completely disorganized, and that he is irremediably deaf. Such cases are of constant occurrence in every community, and while they are calculated to awaken our sympathy for the sufferer, they cannot fail to excite our indignation at the practitioner who, either through ignorance or indolence, or both, neglects to make himself acquainted with the nature and treatment of this disease."

TREATMENT.—The object of all treatment in this affection is to stop the ulcerative process, heal the abrasions and to restore the hearing power. To be quite successful in accomplishing all this will, *in some cases*, require all the knowledge and skill, perseveringly applied, that can be brought to bear by the most experienced aurist, and even that may be insufficient, yet upon the whole, after a very large experience in the treatment of these cases I cannot but regard them as very promising to a persevering course of judicious treatment. Most of them will be found to yield to local treatment alone while some few may require constitutional or internal medication.

As the starting-point in these cases is usually in the pharynx, due attention should always be paid to these parts. When the mucous membrane of these parts is found red and congested, astringent gargles should be used, and when much thickened nitrate of silver in the proportion of 10 to 40 grs. to the ounce of water should be applied once a day with camel's-hair brush.

As to the local treatment of the ear proper, (against which there appears to be so much dread and prejudice by the laity,) I can only say *it is indispensable in every case*, and not any more dangerous than taking medicine internally. Cleanliness of these parts is of first importance. There should be a careful removal of all the morbid material that has accumulated in the ear; this should be done by syringing every morning and evening with warm water. To accomplish this successfully requires more skill than is usually found among laymen, yet, in most instances, we must entrust this important part of the treatment of these cases in the hands of the patient or his attendant.

Care should be observed in using water of a proper temperature (warm only), never hot nor cold There must be no swabbing the ear with a rag or corner of a towel, as is often done to dry it out after syringing, as this will irritate the parts affected and increase the inflammation, but the head should be held to one side so as to allow the water to run from the ear—at the same time the Valsalva method of inflating the ear should be practiced so as to force the water from it while the head is held in this position—then the ear may be dried by twisting a bit of absorbent cotton on the end of a probe or match, and placing the same in the ear and giving it a gentle turn. This will effectually remove all the water.

The syringe should always be used with gentleness and caution, for the reason that in some cases it is not well borne by the patient when rudely handled. The cleansing must always be thorough, for upon this will depend, to a great extent, the success of the treatment. Having thoroughly cleansed the parts affected and removed the water from the same, some astringent solution gently warmed and poured into the ear and held there five or ten minutes will be found useful. For this purpose various astringents are recommended, such as sulphate of zinc, which will be found best adapted to recent cases when used in solutions—from one to three grains to the ounce—or sulphate of copper, which will be found useful in cases of long standing, especially where ulceration has extended to the bone. It should be used in the proportion of one to two or more grains to the ounce of water. Nitrate of silver also has its advocates in the treatment of this affection. Dr. Roosa thinks it is of no value in these cases, "unless used of the strength of 40 grains to the ounce," and cites Dr. O. D. Pomeroy, of New York, as having used it as strong as 480 grains to the ounce of water, causing a slight feeling of fullness in the ear, but no real pain. The result of the application at this strength was an entire arrest of the discharge, and the membrane was found to be healed, on examination, six months afterward. I have no experience with this remedy in these cases, but would infer Dr. Pomeroy's case to have been one of granulations, for which I usually use the potassa cum calce, with entirely satisfactory results.

Nearly or quite all the astringents named in materia medica have been used and recommended in the treatment of otorrhœa or chronic suppuration of the middle ear; but in my opinion the secret of success in the treatment of these cases does not lie so much in the choice of these remedies as in a judicious application of a proper proportion of the same. Carbolic acid, permanganate of potash, bicarbonate of soda, &c., have also been recommended in the treatment of this affection either alone or in combination with some of the remedies named, to overcome the loathsomeness of the disease. Here, too, due regard to proportions is of utmost importance in their application.

I may here state that as a general remedy of real virtue in the treatment of this affection and one which contains the curative and antiseptic properties essential to the successful treatment of this ailment, I know of none equal to my compound preparation known as "Otorrhœa Cure." This remedy has been tested by thousands of sufferers with this affection, and their testimony is such as to have created a demand for the article all over the United States and even in foreign lands. It is carefully prepared under my immediate supervision, and bears my written signature, and may be had at leading drug-stores generally. No condition of the system will contraindicate or preclude its use. Its merits as a curative agent in the treatment of this affection in all its stages may be summarized as follows:

1st. It is perfectly harmless under any and all conditions, for the young, the middle-aged, and for the old, whether the disease is of a few weeks' or of very many years' standing.

2nd. It is very pleasant in its effects, causing no pain, but a feeling of comfort delightful to all.

3rd. It IMMEDIATELY removes all smell, and enables any who have been debarred from society by reason of the unpleasantness or annoyances of the disease, to mingle and associate in any society without the least or faintest taint of the disease being detected about them.

4th. It arrests the discharge by bringing about a healthy action of the sore or ulcerated parts.

5th. It gradually, safely and permanently heals the sores from which the discharge issues.

6th. It much improves the hearing permanently.

What more than this could be desired? What more would we ask? I know of no other remedy that possesses all these merits in the treatment of this affection.

Where polypi or granulations exist they must be removed before a cure can be effected. (See Polypi, page 224.)

POLYPI.

These fungoid growths may be described as vascular tumors, vegetations or granulations; but their classification under different names according to structure or size is of no practical importance. They are one of the commonest results of long-continued otorrhœa or suppuration of the middle ear. They vary greatly in size, shape, density and position. There may be only one polypus or two or more lying side by side, growing from different parts of the drum and ear passage. When situated at the bottom of the passage and small in size, are generally of a bright red color, fleshy and soft in texture; but when grown so large as to appear near the outlet of the passage, they become pale. The smaller, raspberry-shaped or lobular ones are more vascular and gelatinous-like, and will readily bleed when touched. I have had cases where they protruded from the mouth of the auditory canal and almost completely filled the concha. Intense pain-trouble is sometimes caused by these tumors when they completely "block up" the ear passage and prevent all discharge from taking place. Attacks of violent pain in the ear and extreme nervous depression are symptoms of this condition. Though their size may be considerable, their base or attachment is often found to be very small, so much so as to yield to the force of a syringe. I have on several occasions, while syringing the ear in such cases, brought away tumors of this kind of comparatively large size.

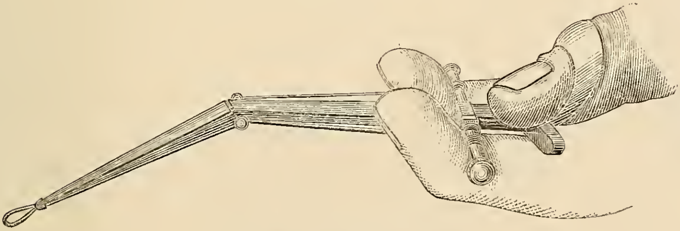
In looking down a speculum where the drum-head has been completely destroyed, it is not always easy to decide, at first sight, whether the red mass at the bottom of the meatus is a small polypus, or simple granulations on the lining membrane of the drum. This, however, is ascertained by examination with a probe, when a polypus will be found to move when touched.

In structure, aural polypi are fibro-cellular as a rule, and the fibrous element will predominate in proportion to the age of the growth. In my experience I find the lining membrane of the tympanum or drum is the most frequent situation from which polypi spring; next, in frequency, the meatus, and then the tympanic membrane. "Whatever their size, structure, or form, whatever situation they arise," (says Prof. Dalby, Aural Surgeon to St. George's Hospital, London, England,) "the sooner they are removed the better. In the first place they intercept the passage of sound to the labyrinth; in the second, they keep up a most unhealthy condition of the whole of the middle ear (these are thus two very efficient causes for deafness); and in the third place they may become indirectly the cause of death by preventing the free egress of discharge from the tympanum, thus inducing purulent absorption, meningitis, or abscess in the brain."

TREATMENT.—Various modes of treatment are recommended for the removal of these excrescences. To remove them and do no more is perfectly useless, for no sooner are they taken away than they at once begin to grow again, *unless* followed by the judicious application of some caustic. I frequently have patients come to me to have these tumors removed who tell me they have had them pulled away by some doctor, but that they soon recurred again, owing no doubt to want of proper after treatment.

Before an attempt is made to examine these tumors the ear should be carefully syringed; light should then be reflected from a mirror worn on the head so that both hands may be free. The growth should then be carefully examined with a probe, to estimate, as nearly as possible, the exact spot from which it springs. If it be a

FIG. 28.

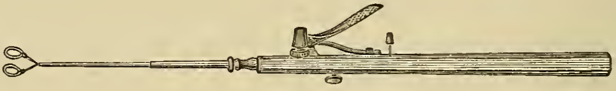


WILDE'S POLYPUS SNARE.

large polypus a speculum will not be necessary and the instrument most commonly used is a Wilde's snare. The noose should be made of fine fishing gimp, as this runs more easily through the rings than wire. When it is placed round the growth, and the point of the snare pressed as close to the root as possible, it should be made to cut its way through. If the polypus is not readily seen without a speculum, the largest one that the meatus will hold being placed in it, and the light reflected down it, the growth may be seized by a pair of rectangular ring forceps and pulled away. This is not easily accomplished when the polypus is a very small one situated in the tympanum and part of the drum-head remaining. I meet with cases sometimes where the polypus protrudes through a small perforation of the membrana tympani. These are the most difficult cases to treat.

In the case of children with a small meatus and for small deeply-seated bodies, Toynbee's levering forceps will be found a useful instrument. For growths situated as they often are in inaccessible corners, various forceps have been constructed. They should grasp well, and be so constructed as to open more widely at the end than at any other part of them that lies within the meatus.

Fig. 29.

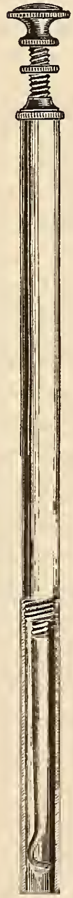


Toynbee's levering forceps.

In cases where the tumor is accessible and the meatus well-formed and of average calibre, my spiral polypus knife, manufactured by F. G. Otto & Sons, New York, will be found useful. This knife is attached to a steel rod and is enclosed within a silver casing, the rod has a thread cut upon it and projects from the upper end of the casing, at which extremity is attached a corrugated capping; the other end of the casing has a plain finish, and is passed into the meatus and gently pressed against the polypus, the surgeon then grasps the capping and screws the knife down to the tumor, which is then drawn into the casing and removed slice by slice at each revolution. No harm can result from the use of this knife, as it cannot cut beyond the casing. I may also claim for it the merit of being comparatively painless in its operation.

My mode of treatment in these cases is as follows: When the tumor is of sufficient size and the meatus well-formed, I use my spiral polypus knife for its removal, and then follow the same by the application of the potassa cum calce. If the tumor is small I use no instrument, but apply the caustic at once. If I were to restrict my means for removing these tumors to a single remedy, I would say let that remedy be potassa cum calce. Ten to fifteen applications of this preparation skillfully applied, will remove almost any tumor of this kind, and in most instances effect a radical cure from regrowth. This is my experience with this remedy in a large number of cases; and as the application causes no pain, patients always readily submit to the operation. I find no difficulty in applying this agent in the cases of little children (three and four years of age), who, after one operation, seem quite willing to submit to any number of applications.

Fig. 30.



Shoemaker's aural polypus knife.

Other caustics are recommended by different authors and teachers, in the treatment or for the removal of these growths, such as nitrate of silver, nitric acid, chromic acid, acid nitrate of mercury, &c., &c. The ear should always be syringed with warm water, and dried with absorbent cotton before any of these agents are used. They should then be applied by a steady hand under a good light, so as not to come in contact with the healthy parts. Care is therefore necessary to guard against applying too large a quantity. Schwartze believes that the galvano-cautery is a more efficient means of removing these growths than the ordinary caustics. I have never tried that agent in these cases.

EXOSTOSES.

Exostoses of the auditory canal occur as round, hard elevations, varying in size, which are either covered with white, or red and thickened integument.

*"I have always found them on both sides, generally more in one canal than the other, seldom on the anterior wall, or adjacent to the membrana tympani; still I have observed no case in which they impaired the efficiency of the canal. *Toynbee* describes a number of such cases as existing on the anterior wall, and in some cases there was appreciable narrowing of the canal on their account. He considers their presence as evidence of a rheumatic or gouty diathesis. In all my observations, the cases occurred in men who were free livers, without, however, any arthritic symptoms; and I have seen these little elevations at the beginning of the bony part of the canal, only as accidental coincidences in declared catarrh of the cavity of the tympanum. The contact with the sound developed great sensitiveness. *Wilde* observed one case of almost complete closure of the auditory canal, by means of an exostosis, which had its origin in the posterior wall. There were also two small exostoses in the other auditory passage.

As there were evidences of progressive inflammation, he applied leeches to the meatus, and gave small doses of bichloride of mercury internally, by which treatment they were diminished in size, and the hearing perceptibly improved."

Toynbee observed a decrease in size in one case, after the use of a solution of nitrate of silver, and recommends the use of iodine internally and externally in such cases.

HYPEROSTOSES of the auditory canal are similar in their symptoms to the exostoses. These remain often after chronic otorrhœa, or spring up after this affection. In these cases, we have generally to deal with an all-sided, uneven narrowing of the auditory canal. The integument is generally found in a reddened condition in these cases.

MASTOID DISEASE.

When the mastoid process is involved in the course of a chronic suppurative process, the ordinary treatment will not avail.

SYMPTOMS.—During the course of acute or chronic suppuration in the middle ear, the patient usually complains of pain behind the ear, and the mastoid process becomes tender and sometimes much swollen. Though pain is not always referred to the mastoid even when these parts are involved. It is of great importance that this affection should be diagnosed as early as possible, in order that the extension of the disease to the brain may be prevented. Prof. Post of New York has seen several cases where death has resulted from the non-recognition of mastoid disease. Roosa says, "Many neglected cases run their course, however, with great suffering to the patient, and with much loss of function without destroying life. This is proven by the frequency with which mastoid cicatrices are seen in our cliniques. The history of such patients usually shows that they have had a narrow escape, but that nature has at last given relief by an external opening through which the pus and dead bone made their way."

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* Von Troltsch on Diseases of the Ear, page 75.

TREATMENT.—A clean cut should be made through the soft parts down to the bone as early as possible when there is redness, tenderness and swelling whether matter has formed or not. Should considerable hemorrhage follow the incision, no alarm need be felt, as it will only inure to the relief of the patient, and in the event of its persistence it may readily be checked by pressure or torsion. After the incision a poultice should be applied and the opening maintained until all danger has subsided. Should *caries* exist the tissues must be well divided so as to give free vent for suppuration. The operation of trephining may here become necessary.

* "Before concluding the subject of treatment, I will offer a few observations on the relation between the presence of discharge from the ear and disease of the bone or brain. Patients sometimes come to complain of having been objected to at a Life Assurance Office, on account of a long-standing discharge from one or both ears; or an opinion is requested whether such a discharge is a valid cause against insuring a life. No doubt a discharge from the ear should always be regarded with suspicion; an opinion which is borne out by an inspection of the following table, showing the relation between the duration of the discharge and the acute symptoms. The cases are taken from a paper of mine in the *Medico-Chirurgical Transactions* for 1851."

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* Toynbee on the Diseases of the Ear, page 362.

DISEASES IN THE BASE OF THE BRAIN.

Age of Patient.	Duration of Discharge.	Duration of Acute Symptoms causing Death.	Post-mortem Appearances.
42	35 years.	Pain in the head, ending in coma: five days.	Pus in the tympanum and labyrinth, and around the medulla oblongata.
17	12 years.	Pain in the head and ear: twenty-two days.	Pus in the tympanum and labyrinth; auditory nerve of a dark color; purulent matter deposited on the medulla oblongata, crura cerebri, and pons Varolii.

DISEASE IN THE CEREBRAL CAVITY.

Age of Patient.	Duration of Discharge.	Duration of Acute Symptoms causing Death.	Post-mortem Appearances.
44	24 years.	Paralysis of the portio dura nerve a few days before death.	Dura mater covering the upper wall of the tympanum thick and ulcerated; bone carious; mucous membrane of tympanum ulcerated.
21	Occasionally for 14 years.	Violent pain in the ear and head; pain in the back and body; curvature of the neck backwards; delirium five weeks.	Tympanic cavity full of pus; a large abscess in right middle cerebral lobe.
23	14 years.	Pain in the top of the head, followed by cerebral irritation; ten months.	An abscess in the left middle lobe of cerebrum; dura mater detached from the petrous bone; the bone soft and carious.
10	5 years; also earache at times.	Headache, vomiting, chilliness, five days; was then convalescent; a day after intense pain in the ear came on, ending in death in five days.	An abscess as large as a small hen's egg in the left middle cerebral lobe; dura mater over tympanum very thick and ulcerated; carious orifice in upper wall of tympanum; tympanic cavity full of scrofulous matter.
Adult.	20 years.	Pain in the head for fourteen days; fever, coma, four days.	An abscess in the right middle cerebral lobe; dura mater ulcerated; upper wall of tympanum carious.
24	3 years.	Cerebral irritation; abscess under the temporal muscle; delirium, coma; some days.	An abscess in the left middle cerebral lobe; the dura mater partly detached from the petrous bone, thick and dark-colored; the bone dark, but not carious.
14	12 years.	Severe cerebral symptoms, coma, death in a few days.	A large abscess above the petrous bone, communicating with the external meatus, through petrous bone and dura mater.
60	2 years, followed by intense pain.	Violent cerebral irritation during thirteen days.	Dura mater covering the petrous bone detached from it, and full of orifices; an abscess in cerebrum; petrous bone carious; tympanic cavity and vestibule full of pus.

DISEASE IN THE CEREBELLUM AND LATERAL SINUS.

Age of Patient.	Duration of Discharge.	Duration of Acute Symptoms causing Death.	Post-mortem Appearances.
15	6 or 7 years.	Pain in right ear; shivering; headache; abscess behind the ear; great prostration; ten days.	Coats of lateral sinus thickened; coagulum in sinus.
45	20 years.	Pain in the left side of the head during the night only; cerebral irritation; delirium; eight weeks.	The cavernous sinuses full of gray-colored matter; mastoid portion of temporal bone carious.
27	Since early life.	Pain in the head, rigors, fevers; an abscess over the mastoid process; stupor, coma; three weeks.	Lateral sinus full of pus; sulcus lateralis carious.
20	7 years.	Shivering, headache, and pain in the right ear followed by abscess behind it; cerebral irritation; death in ten days.	Abscess in left lobe of cerebellum; sulcus lateralis carious; pus in lateral sinus; secondary abscesses in neck and right lung.
3½	2 years.	Pain in the ear and head; convulsions; great prostration; three weeks.	Caries of meatus externus and sulcus lateralis; pus in lateral sinus and jugular vein; abscess in neck; cerebellum soft.
9	At intervals for 5 years.	Pain in the ear and headache; abscess behind the ear; delirium; convulsions; five weeks.	Lateral sinus full of pus; sulcus lateralis carious, and its cavity continuous with that of the tympanum; purulent deposits in the lungs.
19	At intervals during 2 years.	Intense headache; tenderness of abdomen, great physical prostration.	Abscess occupying nearly the whole length of the right hemisphere of cerebellum; petrous bone carious and soft; tympanum full of pus; cerebrum healthy.
32	2 years.	Pain in the ear and side of the head; drowsiness, stupor, and coma; six weeks.	Abscess in right hemisphere of cerebellum; petrous bone carious; dura mater ulcerated.
Adult.	16 years.	Headache, stupor, coma; a few days.	Abscess in right hemisphere of cerebellum; external meatus and petrous bone carious.

It is true that many persons live long, having had, during the whole of life, a discharge from the ear without any disease of the bone: others live many years with a discharge, but at death the bone and dura mater are found affected, and might under many circumstances have assumed an active form of disease, ending in death. It is important, therefore, to be able to form an opinion respecting cases of the kind. To do this, it is first necessary to decide upon the source of the discharge. If it arises from the dermoid meatus, the membrana tympani being entire, there is, as before stated, most probably irritation in the tympanic cavity or mastoid cells, of which irritation the discharge is the symptom. Unless there were simply some eczematous state of the meatus to account for the discharge, and unless the hearing power were perfect, such a case should be looked upon with suspicion, especially if attended with any symptoms of brain or cerebral irritation. Again, if the discharge issues from the tympanic cavity through a small or a valvular opening, and it is requisite to blow the nose forcibly to clear out the tympanum, there probably is, or will be, some affection of the bone, from the accumulation of the discharge. If there is a large orifice in the membrana tympani, or that membrane is absent; if there is no ulceration of the mucous membrane of the tympanum; if there is some power of hearing remaining; and if by pressing and tapping the region round the ear, no pain is felt; and if there are no other symptoms of disease in the ear or head, I think it may be assumed that there is no disease of the bone; and that by attention to daily syringing, and the other plans alluded to when speaking of the treatment of these affections of the ear, there is a fair prospect of the disease remaining confined to the mucous membrane of the ear. On the other hand, it becomes a duty to state that any negligence on the part of the patient, by which the discharge should be allowed to collect so as to fill up the orifice in the membrana tympani—a blow on the ear, an attack of fever, or any severe illness, might cause an irritation in the ear, which, if unattended to, might advance to the bone."

CARIES AND NECROSIS OF THE TEMPORAL BONE.

All parts of the temporal bone may become carious as the result of a chronic suppurative process. The bony portion of the auditory canal is frequently found to be the seat of such a morbid condition. Inflammation of the brain and affections of the venous circulation may occur even when the caries is confined to the outer ear. It usually results from chronic suppuration of the middle ear, and from the anatomical relations of the cavity of the drum must be regarded when involving any part of the walls of this cavity, as likely to cause serious consequences.

PROGNOSIS.—The prognosis of caries and necrosis of the temporal bone is *always* grave. Young children will throw off quite large portions of the bone and make a good recovery, while older persons are likely to succumb to one of the many consequences. Much will depend on the situation of the dead bone. Caries and necrosis of the upper and lower wall of the middle ear is most dangerous. Caries of the mastoid, especially in children, is often recovered from.

TREATMENT.—This will consist in thoroughly cleansing the affected parts, two or three times a day, with warm water and syringe, and giving free vent to the accumulations of pus and dead bone. The general health and habits of the patient must also receive careful attention. It is not possible to give specific rules for treating caries and necrosis of the bony parts of the ear. Each case must be treated according to its requirements. All should receive careful and discriminating attention.

CEREBRAL ABSCESS.

* "The proceedings of pathological societies and surgical records show, that abscess of the cerebrum more frequently results from disease of the middle ear than from any other single cause. Of seventy-six cases of cerebral abscess collected by Drs. Gull and Sutton,† twenty-five, or about one-third, were directly traceable to chronic suppurative processes in the middle ear. Lebert,‡ in his article upon this subject, considers that aural disease is the cause of cerebral abscess in about one-fourth of the published cases.

There is usually caries in connection with the cerebral abscess, but cases have occurred in which, although the disease of the ear extended to the brain, there was no death of bone. The anatomy of the cavity of the tympanum, especially of the roof, or tegmen tympani, where a process of dura mater actually extends into the tympanic cavity, and where there may normally be a gap in the bone, has taught us how easily this may occur. The cause of the extension of a suppurative process to the brain is undoubtedly very often that which Mr. Toynbee so clearly sets forth in his chapter on this subject—that is, the non-escape of the pus externally through the membrana tympani. The perforation of the membrana tympani in acute inflammation usually prevents any such disaster as the passage of the pus to the brain or the circulation.

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* Roosa's Treatment on the Diseases of the Ear, page 444.

† Reynold's System of Medicine, vol. ii., p. 544.

‡ Virchow's Archiv, Bd. X., p. 391.

Rupture of the membrana tympani is, therefore, a conservative process, if suppuration has once been established; for there is no other safe way of escape for the pus, except through the Eustachian tube—a means of exit which is one of the last that nature chooses. Abscess of the brain in acute disease was only once observed by Mr. Toynbee.

A direct communication usually takes place between the diseased mastoid or petrous portion of the temporal bone and the brain substance through the meninges, but the dura mater and other membranes may be healthy, and even a portion of healthy brain may lie between the diseased bone and the cerebral abscess. The chronic disease of the ear may be going on very well, until some mechanical injury—exposure to cold, or the like—sets up an acute process, which extends to the brain through the delicate bony walls of the tympanic cavity, or the cancellous structure of the mastoid bone.

Patients suffering from chronic suppuration of the middle ear cannot be too much guarded against blows or falls upon the ear, or against exposures to sudden changes of temperature, drafts of air, or the like; for the table of cases appended to this chapter, shows that meningitis, cerebral abscess, and pyæmia may, from such exciting causes, be the termination of a purulent discharge from the ear.

The symptoms of brain disease are sometimes very insidious. At times there is a chill or a convulsion, or nausea and vomiting; at others, only increased pain in the ear, followed in rapid order by paralysis, coma, and death. In very rare cases there are absolutely no symptoms, except those of a chronic suppurative process in the ear, until death occurs."

"It is interesting to note how slowly the profession came to recognize the fact that when pus was found in the brain communicating with the ear, that it was on its way inwards, and not making an external opening. It seems to have been hard for the medical men of a few generations back, to believe that aural disease could cause any serious affection, or that it was a matter of much account, although people were dying all about them from the results of aural disease alone. Lebert* says that Morgagni, 'with his good tact and close observation of Nature,' discovered that the ear was often the cause of purulent affections of the circulation and brain substance; but Itard took a step backward, and discovered a kind of cerebral abscess which broke out through the ear. Lallemand again placed the subject in its right light, and showed, what we now clearly see, in cases of cerebral abscesses occurring in connection with suppuration of the ear, that the organ of hearing was the part first affected."

†"The following figure may render the formation of abscess more clear.

You here see how the young cells gradually collect at the points where the connective-tissue corpuscles lay, while intermediate substance constantly decreases, and how in the middle of the drawing, in the centre of the inflamed spot, the groups of cells unite and

FIG. 31.

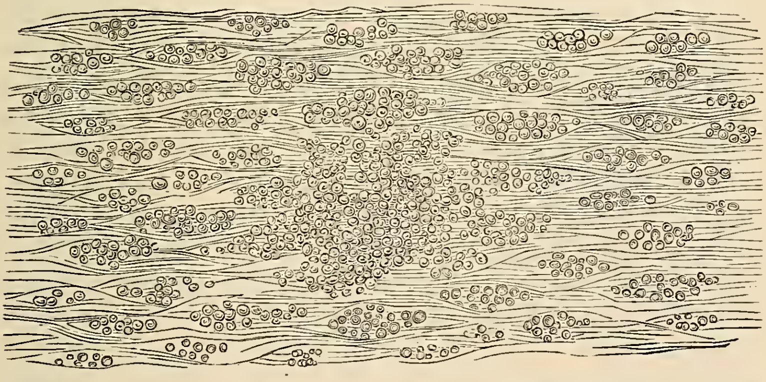

Diagram of purulent infiltration of the cutis connective tissue, forming an abscess in the middle. Magnified 350 diameters—after Billroth.

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* Virchow's Archiv, Bd. IX., p. 382.

† Billroth's Surgical Pathology by Hackley, page 281.

form a collection of pus; every abscess at first consists of such separate collections of pus; it grows by peripheral extension of the suppuration."

"It is generally believed that a *suppurative* process in the ear is necessary for the production of an abscess of the brain, and this is probably the fact; but one case that I observed, leads me to suspect that there may be such a thing as a chronic cerebral abscess leading to disturbing aural symptoms, such as tinnitus aurium and pain in one side of the head, without any primary aural affection. I treated a gentleman of about twenty-nine years of age, for some months, for such symptoms as have been indicated, and when he died a cerebral abscess was found. He could hear the watch for but three inches from the left ear, which was the affected one, and the drum membrane was sunken. I supposed the case to be one of chronic proliferous inflammation of the middle ear. The patient got no relief; he became very despondent on account of his tinnitus aurium and pain, gave up his business, and died at Sag Harbor, L. I., of malignant pustule, about two years and a half after I first saw him, and three years and a half after his first aural symptoms. Dr. Geo. A. Sterling, of that place, made a post-mortem examination. He found 'great injection of the pia mater over petrous portion of temporal bone, and an abscess about the size of a ten cent piece in the brain substance. It was bounded by inflammatory adhesions, and contained about ten drops of pus. The abscess was situated on the left side, in the superior lobe, one inch from the median line and two inches from the coronal suture.' This patient never had a suppurative inflammation in the ear, and it is possible that the cerebral abscess was the cause of his very distressing symptoms, although the data are not full enough to allow us to give a positive opinion. There is no account of an examination of the temporal bone.

The text-books on pathology give very full accounts of cerebral abscess. The author has had but the space to plainly mark them out as one of the consequences of chronic suppuration of the middle ear."

AFFECTIONS OF THE BRAIN, OR PYÆMIA, RESULTING FROM DISEASE OF THE EAR.

*"The frequency with which fatal effects follow inflammatory affections of the ear has long attracted attention, Mr. Toynbee having especially thrown light upon their nature and pathology; so that it is no longer necessary to dwell upon the importance of the subject. The fatal result is the consequence either of caries, affecting the brain or vessels by continuity, or of poisoning thro' the veins of the diploe; or abscess may form in the brain in the neighbourhood of an inflamed tympanum without caries or any apparent means of propagation of the morbid action. In addition to these results, fatal hemorrhage has taken place from ulceration alike of the carotid artery and of the lateral sinus. When caries of the roof of the tympanum exists, it is often covered with a thick layer of lymph, the value of which as a preservative against the spread of the disease has been pointed out by Mr. Prescott Hewitt; and I have observed in dissecting petrous bones in which the tympanum had long been diseased, that a new deposit of bone had been formed beneath the dura mater, evidently serving to guard against the spread of the disease. The thin, and often partially deficient, walls of the tympanum are in contact not only with the dura mater, but with the lateral and superior petrosal sinuses and the carotid canal; and from its lining membrane there extend more than one direct communication with the vessels of the dura mater. But besides this, the external meatus borders also on the brain and sinus; and the large cavity of the mastoid cells, from which, when purulent action is once set up, a free escape of its products is extremely difficult, is separated from them but by a thin layer of bone. Affections of the meatus, therefore, when they tend to implicate the bone, are not less dangerous than those of the deeper parts. Indeed, Dr. J. Gruber gives it as the result of his experience that fatal affections originate most frequently in diseases of the external portion of the ear.

Whenever, during the existence of a discharge from the ear, serious symptoms of brain disturbance set in, or rigors occur, every surgeon would now give to the local affection his utmost attention.

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* Hinton's Aural Surgery, page 233.

The only error at all likely to occur is that, the ear affection being disregarded by the patient, and not mentioned by him, the surgeon might take the one affection for fever or treat the other with quinine. And there is the more danger of such error, because sometimes fatal symptoms will supervene and run a very rapid course without any warning. Twice in my experience it has occurred that patients under my care for chronic inflammation of the tympanum, connected with perforation of the membrane, in whose symptoms neither I nor any of their friends detected marks of danger, have succumbed within a few days to brain disease. Both of the patients were young; one was a woman of 24, of good health, who had been subject to discharge since scarlatina in childhood: the meatus was very narrow and the mucous membrane was spongy, but it had become almost healthy under the treatment before described as used by me in perforations, and the hearing had greatly improved. Nothing suggested danger to me. The other case was that of a gentleman aged 26, on whom, two years before, I had performed incision of the left membrane for old catarrh of the tympanum attended with discharge from the meatus, with very satisfactory results, the hearing being much improved, and all morbid appearances ceasing. The right ear also improved in hearing. The patient went to Canada, and continued with good hearing and free from annoyance for more than eighteen months, when a slight discharge came on. On his calling on me about two years from the date of the incision, there was a small perforation of the membrane, not in the position of the incision but anteriorly, and the edges were spongy and granular. I used Politzer's inflation, and applied a solution (ʒj—℥j) of nitrate of silver to the granular surface, and the case appeared to progress perfectly well till within little more than a week of his death. I do not know how such cases should be distinguished in the future. Mr. Toynbee has reported instances in which, after death, abscesses were found in the brain substance, which, from their characters, must have existed for many months; but it is doubtful if these cases are of the same kind. I had not the opportunity of witnessing the last attack in either case.

When threatening symptoms declare themselves, such as rigors with or without ceasing of the discharge, pain in the ear or side of head, giddiness, fever, or loss of power of any of the muscles, the aim of the treatment is simple; namely, to subdue any newly arisen inflammation, and above all to secure a perfectly free exit for pus wherever it may be. In the vast majority of cases impeded discharge is or has been the prime cause of the evil. With this view all polypoid growths, or even granulations springing from diseased bone, if they are large, should be removed; the Eustachian tube should be opened, if it is obstructed, by Politzer's bag, or, with caution, by the catheter, and air passed daily thro' the tube and tympanum. If there be not a free exit for matter contained within the tympanum, the membrane should be incised or the existing orifice enlarged. And the most scrupulous care should be given to detect any symptoms of the presence of matter pent up beneath the periosteum. This is found generally in one of two places; either over the mastoid process externally, or within the meatus, at the posterior or upper wall. Any redness or swelling, with tenderness of these parts, should prompt to immediate action.* Free incision, carried completely thro' the periosteum to the bone,† should be made in the swollen part. The value of incision over the mastoid process is now well understood; but this part should not be regarded to the exclusion of the posterior and upper wall of the meatus, where an efficient incision will often give even greater relief. In one case of sudden exacerbation of long-standing discharge, in which the symptoms were of the gravest character, I incised a red swelling in this part; no considerable relief followed for three days, and I was again sent for, but before I arrived a large discharge of pus had escaped from that part, having worked its way thro' the bone, a small orifice in which could be felt by the probe. Immediate recovery followed; a very free discharge of pus continuing for several days. On one occasion I opened a large abscess over each mastoid process in a boy of twelve, with entire relief. But if the division of the periosteum over the mastoid process leaves the symptoms unchecked, the perforation of the mastoid cells should not be delayed more than a day or two. It is easily carried out. Often when pus is contained within the cells the bone

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*I think it may be said that swelling, even tho' painful, in *front* of the ear, is scarcely ever of serious import

† Students are very apt to fail in this.

is softened and the knife will penetrate it, or a strong probe will break it down. When this is not the case, a gouge or drill may be used; I employ a drill furnished with a moveable guard, so that the bone can be penetrated to any desired extent. The best point to select is a spot on a level with the upper border of the meatus and about half an inch behind it; the perforator, directed slightly forward, may be allowed to penetrate three-quarters of an inch. Even if no pus immediately escapes, relief is very often given, and a discharge sets in afterwards.

In the 'Medico Chirurgical Transactions' for 1868, p. 231, I have reported a case in which relief was given to most threatening symptoms by perforation of the mastoid process, in the case of a clergyman, aged 58, who had suffered for about two months from inflammation of the meatus and tympanum, with perforation of the membrane, attended all the while with very free discharge. After apparently perfect relief had thus been given, however, a large abscess formed beneath the sterno-mastoid muscle, apparently in connection with the mastoid process, and was freely laid open in its whole extent. The patient rapidly regained perfect health; the orifice in the membrane, which had been a line and a half in diameter, healed, leaving a scarcely detectible scar; and the hearing became again almost perfect for the voice, and for the watch $\frac{15}{40}$.

In this case the soft parts over the bone were swollen to more than an inch in depth; but redness and swelling must not be regarded as essential indications for the operation. Pus and sequestra of dead bone may be contained within the cells, and give rise to urgent symptoms without any change in the external tissues. It is of the utmost importance not to delay too long; and since the ether spray will generally suffice to deaden the pain, incision over the mastoid process should be had recourse to promptly in every, even doubtful, case. I may repeat that I have never regretted making the incision, and scarcely ever decided against making it without regretting that I did not.

When threatening symptoms first arise, of course vigorous preventive treatment would be adopted: perfect rest, fomentations, mild aperients, sedatives at night, and the free application of leeches. By means of this kind, especially long-continued rest, cases of the gravest aspect have perfectly recovered. Mr. Prescott Hewitt reports the case of a young woman, in whom, after protracted symptoms of pyæmia thro' the lateral sinus, entire restoration was secured by good support.* And the numerous cases in which large masses of dead bone, often including almost the entire labyrinth, have come away, with no permanent damage to the health, prove how strong are the recuperative powers, provided only free exit for discharge is secured and the strength sustained. Dr. Ogle † mentions the case of a soldier, who suffered from aberration and noises in the ears. After two years a fetid discharge came on, and he became deaf. The discharge and deafness both ceased after a time, but he shortly died of phthisis and softening of the brain, and each tympanum was found diseased, the membranes being destroyed. It is probable that the starting-point of the disease here was in the ear. The patient had been often punished for malingering."

PARALYSIS.

The position of the portio dura in its course through the tympanum renders it especially liable to become affected when this cavity is the seat of inflammation, so that we not unfrequently find facial paralysis associated with a purulent discharge from the ear. There are three positions in which this nerve may be affected: 1st, when it is within the cranium; 2nd, in the temporal bone; or, 3rd, superficially, after its exit from that bone. The last of these three forms of the paralysis is generally attributable to cold, and gets well sometimes in a few days, or at others it may last for many months. But it is the palsy that is caused by an affection of the nerve, while it is in the aqueduct of Fallopius that we have now to deal with. In "Reynold's System of Medicine," Romberg has stated that whenever the source of facial palsy is in the temporal bone, the uvula of the patient invariably points to the paralyzed side, and that there is always unilateral paralysis of the velum paliti.

When the disorganization of the tympanum has gone to the extent of caries of the bone, (this complication is generally in cases where scarlet fever has been the origin of all ear trouble,) it is not likely that recovery will take place, and, so far as I know, no case where this has happened is on record; but when there has been profuse suppuration without any evidence of caries I have noticed on several occasions considerable improvement when the condition of the tympanum has become more healthy; still I have never seen a complete recovery when there has been profuse suppuration. Beyond the usual applications for the ear no treatment especially directed to the paralysis, so far as I know, is likely to be of any service in these cases; but the cases to which I wish particularly to direct attention are somewhat different to these; they are full of interest, and I am convinced that the cause of the paralysis is oftentimes overlooked. The reason why it is overlooked is, that there is no discharge from the ear, and sometimes only very little deafness to call attention to the ear. The history of these cases is brief: an occasional earache with slightly impaired hearing, followed after a few attacks with facial palsy. Perhaps the patient is not seen for many months afterwards, the pains in the ear have been forgotten, and the slight one-sided deafness is not mentioned.

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* "Pathol. Soc.," May 17, 1864.

† "Med. T. and Gaz.," 1864, p. 566.

Now if the narration of these two symptoms is not elicited from the patient, the conclusion which the surgeon very naturally arrives at is, that the facial palsy depends on a lesion of the nerve after its exit from the stylo-mastoid foramen, and in answer to inquiries as to the prospects of recovery gives a favorable opinion, tells the patient he may hope to be well within perhaps twelve months (the superficially induced local palsy seldom lasts longer than this), and the fallacy of his opinion is proved by time; for it is not a very unusual circumstance in these cases for the paralysis to be permanent.

Blistering over the mastoid process is recommended by some authorities. Iodide of potassium may be given with the hope that the products of inflammation surrounding the nerve may be absorbed. Electricity intelligently applied may, in some cases, be found a useful agent in the treatment of such cases.

PART VIII.

DISEASES OF THE INTERNAL EAR.

DISEASES OF THE INTERNAL EAR.

NERVOUS DEAFNESS.

Nervous deafness is a primary affection of the auditory nerve or labyrinth, or both, and was at one time regarded as of very frequent occurrence; but with every increase of our knowledge of the morbid anatomy of the ear, and with every improvement of our method of examination, the diagnosis "nervous deafness" is less frequently pronounced.

Dr. Von Tröltsch says: * "We must decide that a patient is affected with nervous deafness, when we can find no change in the material structure of the auditory apparatus, from which the diminution of the power of hearing can be deduced.

Of course, such a diagnosis requires a very exact knowledge of the parts, and a well founded capability of observing slight deviations from the normal; and nowhere is the degree of advancement of the physician, and the stage of development of science, better shown than in nervous diseases.

With every increase of our knowledge of the morbid processes, taking place this side of the labyrinth, and with every improvement of our method of examination, the field of nervous affections of the ear becomes smaller.

The diagnosis 'nervous deafness' will be the oftener made, the less the surgeon is able to distinguish the different affections, the less he understands how to examine the affected portions, and the less knowledge he has of the pathological changes of the external and internal ear.

Examinations of other fields of science, as well as the history of our art, teach us that in proportion to the improvement of the objective modes of examination of nervous complaints, and the progress

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* Von Troltsch, Diseases of the Ear, translated by Roosa, page 217.

of science, together with the influence of pathological anatomy, the diagnosis '*nervous*' becomes, to a certain degree, a chance hit, a declaration of not knowing and not finding, and is only a common one for those who use it willingly.

I will call only one department of disease to your recollection, in which we were formerly contented with the frequent diagnosis 'nervous affection,'—affections of the female genital system. Now, these are found to depend very often on morbid material changes, and we are able to make a more favorable prognosis to affections of the parts, when properly treated, which were formerly regarded as incurable.

Then, gentlemen, let us confess, that we only name those affections 'nervous,' which we do not comprehend, and which, as a rule, we cannot improve.

William Kramer, one of the oldest and most distinguished aural surgeons of the present time, says, that while formerly he considered nervous affections to be the most common of all of the ear, almost exceeding fifty per cent. of all the cases, now, with the advance in pathological anatomy, especially in the study of exudations, he has reduced their frequency to a minimum—four in a thousand.*

Let us see, now, what we can say with reference to the anatomical and clinical facts in their relation to nervous deafness.

Its anatomical substratum must necessarily, before all things, be sought for in the labyrinth, in the auditory nerve and its source of origin, and finally in the brain; whose disturbances of circulation will always declare themselves on the inner ear, since the vessel carrying blood to the labyrinth is a cerebral artery, and the veins, venæ auditoriæ internæ, empty into the venous sinuses of the dura mater. Rudolph Wagner says: 'One of the most humiliating tests of the incompleteness of our knowledge of the functions of the parts of the brain is this—that the central organ of hearing is entirely unknown, while we certainly know that for sight. I think it probable that it is to be sought for in the medulla oblongata spinalis.' Zeitschrift für ration. Medezin. 1861. Book 10, page 277.

Very few morbid changes have as yet been observed in the labyrinth, which fact is due to the unexplored condition of this branch of science; and we are not certain if the processes which have taken place in the middle ear are primary, and those of the internal ear only secondary. And furthermore, its condition may depend on the greater or less quantities of otolithes, and the presence of the often-spoken-of black pigment, which, in almost every healthy ear, may be found in different parts of the covering of the labyrinth.*

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*See "Kramer's Aural Surgery of the Present Day." Ohrenheilkunde der Gegenwart. Berlin. 1861. Page 39.

Many appearances may depend on post-mortem appearances, which very quickly show themselves in these parts, and make the decision difficult.

Toynbee, who has made the greater number of sections of ears, gives, as among the appearances of the labyrinth, the following: —extravasations, exostoses, thickening and atrophy of the integuments, insufficiency of the semicircular canals, hypertrophy of the cochlaeris muscle. However, his descriptions are extremely short and fragmentary, and he does not appear to attach much importance to 'nervous deafness' in his text-book.

Voltolini speaks much more of the diseases of the internal ear. In almost every temporal bone of deaf persons which he examined, he found morbid changes in these parts, and therefore, he, like *Kramer*, except that his opinions are based on anatomical grounds, considered nervous deafness the most common of the diseases of the ear.†

He found thickening of the integuments, calcareous formations, and at one time a fibro-muscular tumor, absence and excess of otolithes, collections of pigment, amyloid degeneration of the auditory nerve, and once a sarcoma of the nerve.

Clinical facts are wanting for the confirmation of this diagnosis, nervous deafness, and we must for the present adhere to those facts, which are in turn wanting in anatomical proof.

This is often said by sick people, that after somewhat large doses of quinine they have suddenly been attacked by a violent singing in the ear, accompanied by considerable difficulty in hearing: a distress, which generally—although not always—entirely disappeared after a while. Generally these phenomena appear, accompanied by other narcotic or poisoning symptoms. They must, therefore, no doubt, be attributed to the effect of Quinine upon the brain, or upon the vascular system. In this connection also belongs that transient deafness, which *von Scanzoni* several times observed to appear over the whole body, after the application of leeches to the vagina, usually with a general vascular excitement, and with the eruption of *Urticaria.* Hysterical and chlorotic people often experience peculiar vacillations in the power of hearing, which together with the negative state in the ear are in such singular sympathy with the general health, and the sexual functions, that they can only be denominated 'nervous' phenomena. As in fainting, a transient singing in the ear, together with difficulty of hearing, appears, so also is it the case with the longer enduring anæmia of the brain after large loss of blood. To this may be added, in part at least, that hardness of hearing, which is observable in people suffering from typhoid fever with negative, objective symptoms, a difficulty which generally disappears of itself in convalescence with the increase of the general health, or under an invigorating treatment.

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* Vide Kolliker's Geweblehre. 1852. § 234, and § 235.

† Virchow's Archives, book 22, hp. 1–2.

As is well known, severe concussions, or a fall on the head, excite 'nervous' deafness. Of the former class I am able to relate to you, among other instances, a very striking one from my own experience. In the summer of 1858 an artillerist, Martin Baumann from Ansbach, 21 years old, was brought to me by the military surgeons Drs. Rast and Hausner. He himself a strong, and as yet always healthy man, states that he received in his ninth year a blow on the ear from his father, in consequence of which he heard nothing in that ear for eight days. Whether he had any suffering with it, or on which ear he received the boxing, he cannot say. But he asserts quite confidently that he was able to hear perfectly well after that, until within two days. He states, that two days before, during artillery drill, he was connected with the service of a six-pounder gun; and that he stood during the firing about two feet from the muzzle, his face fronting the gun. The first six shots, which followed each other at intervals of about ten minutes, called up a strong and unpleasant concussion. At the seventh shot he felt an extremely violent pain in both ears, as if a javelin was stuck through his head. From this moment he was deaf. This violent pain lasted about two hours. After that he experienced only a strong singing, together with a dead-feeling in his head. The patient, who spoke unnecessarily loud, understood only when spoken to slowly and distinctly through an ear-trumpet; and he did not hear a loud ticking clock, on the mastoid process, but only on the frontal bone; and then he stated that he did not *hear*, he only *felt* a gentle concussion.

In his organ of hearing, there seemed to be nothing out of order, omitting a slightly elongated red spot in the back half of the right membrana tympani behind the middle of the hammer. This spot, which was a slight linear slit, or small extravasation, rapidly grew paler, and continually smaller, and after two weeks it was scarcely discernible. Air blown in by a catheter entered easily and clearly from both sides, without any further phenomenon: except a dull feeling in the head, the sick man was perfectly well. He had appetite, and all his functions were normal. His treatment in the military hospital consisted at first of calomel and jalap in aperient doses, simultaneously with cuppings on the neck:—afterwards a rubbing of *tartarized antimony* salve behind the ears. The condition remained steadily the same, except that the patient gradually screamed less boisterously. Twelve days after the accident I commenced a treatment by faradization of the ears, first with a quite weak and brief current, slowly increasing the strength of the current, and the duration of the treatment. The negative pole was held in the entrance to the ear, which was filled with water,—the positive pole rested on the moistened *mastoid process*, and afterwards on the neck also. After the treatment the buzzing was a little stronger for a time. A violent pain in the ear accompanied stronger currents, and also some injection on the malleus. This electric treatment was continued daily for six weeks with slight interruptions without any change of the condition. The patient felt as well before as after, except the continued deadness in the head. Simulation, which must be guarded against among soldiers, was not to be thought of judging from his whole conduct. Moreover, during the whole time of his treatment he was continually watched in the military hospital: and also after he had been dismissed as a soldier to his home, where he followed his trade as a glove-maker. Report was made at the year's end, that his deafness continued unchanged, although it became soon less apparent as the very intelligent patient quickly accustomed himself to observing the motions of the mouths of speakers.

I believe, it can scarcely be explained differently than that this violent explosive concussion, in this perhaps peculiarly predisposed person, had brought about a paralysis of the acoustic expansion, either directly (as sometimes the destruction of the optic functions is reported by a sudden dazzling), or indirectly in consequence of hæmorrhage in the labyrinth.

If deafness occur after a fall on the head, it may often connect itself, with changes in the brain, or with a fracture of the base of the skull, which, as you know, winds its way frequently through the temporal bone. For instance, there lives here a whitewasher, an extremely jovial fellow, who many years ago fell from a church-steeple, which he had to whitewash. He lay for a time in the Julius Hospital, in consequence of a fracture of the skull; and, since this accident, is so stone-deaf that he assured me, that for the sake of trial, he had placed himself near a cannon being discharged, and that he had certainly *felt* a concussion in his head and feet, but that he had *heard* nothing of the report. Such cases of absolute want of appreciation of sound are extremely rare; for even deaf and dumb people frequently react under a strong noise; for instance, the report of a percussion-cap, or the ringing of a bell near their head.

One of the most worthy contributions to the science of nervous deafness we owe to late French investigators, especially to Dr. P. Menière of Paris Deaf and Dumb Institute, who unhappily died at the beginning of this year, and who was altogether one of the most meritorious workers in the province of aural surgery. Menière, in the year 1861, drew attention to a series of most remarkable diseases, which appeared under the form of an apoplectic congestion of the brain, with sudden vertigo, vomiting, great singing in the ears and a fainting condition, and which frequently left behind a certain impediment in motion, a continuing unsteadiness in standing and walking, and thus gave the surgeon from the beginning an impression of a congestive affection of the brain; while through the constant recurrence of all these disturbances, and through the remaining of a generally very remarkable difficulty in hearing for which no assignable change in the ear could be found, they decidedly proved themselves to be indicative of an affection of the inner part of the ear. The affection of the hearing proved itself to Menière, despite all local and general methods of treatment, to be incurable; while the universal disturbances, which appeared so threatening, disappeared gradually, and the patients afterwards enjoyed complete health. Menière, as a warrant for the presentation of this new form of disease, communicates a considerable series of histories of patients, abridges his experiences on this point in the following propositions:

1. A hitherto entirely sound organ of hearing may suddenly become the seat of functional disturbance, which consists in a humming in the ears of very varied nature, now continuous, again intermittent, to which a decline of various degrees in facility of hearing soon joins itself. 2. These functional disturbances have their seat in the inner part of the auricular apparatus, and have the power of calling up apparent brain fits, as vertigo, stupefaction, unsteady motion, whirling motion, and sudden concussion, beyond which they are accompanied by inclination to vomit, actual vomiting, and by a sort of fainting condition. 3. These fits, which occur after free intermissions, are always followed by a greater or less degree of difficulty of hearing, and more frequently the power of hearing becomes suddenly completely annihilated. 4. It is most probable that the material change which lies at the foundation of these disturbances has its seat in the semicircular canals.

This view of the conjectural seat of the disease in the semicircular canals, Menière supported partly by a similar case, on which a post-mortem was had, partly by certain physiological experiments. Concerning the first, the case is of a young girl, who in a nocturnal journey on the imperial of a diligence during her menstrual period, caught a severe cold, became suddenly completely deaf, experienced thereby a continuous vertigo, at each attempt to move vomited, and on the fifth day died of the disease. The brain and spinal cord were entirely sound, and the ear showed no pathological change whatever, except in the semicircular canals, which were filled with a red, plastic lymph, a sort of bloody exudation, of which scarcely any traces showed themselves in the vestibule, and none in the cochlea. The physiological experiments, which must be here mentioned, are those of *Flourens*, who, as is known, after the injury of the semicircular canal, in doves and rabbits, noticed different kinds of dizzy motions, unsteadiness in moving and resting with evident loss of equilibrium, and more frequent tumbling over. An observation of *Signol* and *Vulpian*, recently laid before the society of biology, is of great importance to this topic. It is of a rooster, who in a combat with his equal, presented precisely the same disturbance of equilibrium, and other manifestations in movement and rest, as Flourens noticed after the injury of the semicircular canal, and the like, and as Menière reported in the former cases. At the post-mortem section every abnormity of the brain and its integument was wanting; on the contrary, there was a partial necrosis of the bones of the temples, by which a greater part of the inner and middle ear of one side, as also the semicircular canals, were for the most part destroyed. This instance seems, indeed, to a certain degree to speak for the correctness of *Flourens's* discovery, and serves at all events as authority for the assertion that diseases of the inner part of the ear are calculated to call forth identically the same results as the direct experimental injuries of this organ.

These communications are extremely worthy of notice, and incite us to exact observations and experiments in this direction. The subject, nevertheless, may in no manner be considered as concluded, as manifold demonstrative dissections and various corroborations of the facts of observation are necessary to it. I myself remember, in my somewhat extensive practice, only a single case which was analogous to that of Menière, although here also certain symptoms were not to be rejected, which implied a catarrhal process in the tympanum.

In addition, we must remember that in the symptoms above introduced, one at least, vertigo, is called up by various processes of diseases of the ear; especially by the stoppage of the meatus by ear-wax or other material, by acute catarrh and purulent processes in the cavity of the tympanum. We have seen that, if these conditions cause vertigo, we must consider this preëminently as a symptom of abnormal pressure, which is made upon the drum, and therewith upon the chain of little bones, or upon the last articulation of the latter, the stapes, and its fenestra. The increase of the pressure, which was produced in a peripheral manner, and which was transferred from the stapes to the vestibulum, must necessarily place the semicircular canals in an abnormal state of pathological irritation, and this condition might be designated as the same with all these different forms of disease of the ear (which are followed by vertigo): and perhaps it is of importance only for the extent of the appearances and their further results, whether the irritation is one transferred from the periphery or arising mainly in this division of the labyrinth itself. In any event we must, for the present, be on our guard not to infer from similar instances that there is a primary affection of the semicircular canals or of the nervous apparatus. We must be doubly careful in the supposition of a nervous cause for affections of the ear, because catarrhal processes of the tympanum, pressing upon the wall of the labyrinth and the two fenestræ, often localize themselves, and a high degree of deafness appears under manifest symptoms of irritation of the inner part of the ear; while one of the chief points of the diagnosis, the changes on the tympanum, are little manifested, and the remaining inferences which result from the condition of the mucous membrane of the throat, and the use of the catheter, frequently exist only in the beginning of the affection. That diseases of the middle ear often assert themselves in a secondary manner on the labyrinth we noticed before, where we found in every case of catarrh of the Eustachian tube, in consequence of one-sided atmospheric pressure, which weighed upon the tympanum, that the stapes is pushed further inwards, and thus the fluid of the labyrinth is exposed to an increased pressure, which condition, if somewhat longer continued, will leave behind it lasting disturbances of the nutritive supply of the ear.

The degree of functional disturbances cannot be determined, in the Ear, as in the Eye, where even when the media are obscured, we can make an exact conclusion as to the condition of optic nerve and retina. The physiology of the faculty of hearing has, unhappily, thus far, not taught us what degree of deafness can arise from simple peripheric causes, and from what point we must suppose an affection of the nervous apparatus. Even if we can connect certain higher grades of deafness, from universal hypothetical grounds, with a lack of perceptive organs, still every intimation of a settled boundary line is wanting, before which peripherical interference with the conducting of sound is possible, and behind which only dullness of the brain or the acoustic nerve and its ramifications is imaginable. It is certain, and established experience proves, that primary processes in the cavities of the tympanum presuppose a high degree of deafness, perhaps with an inclusion of the influence which they exercise through the fenestra in a mechanical way upon the contents of the inner part of the ear. Let us consider, by way of illustration, a case where the stapes is immovable and surrounded by masses of bone; consequently, the fenestra ovalis is quite shut; furthermore, the membrana tympani secunda is converted into a thick, inelastic or chalky plate, and the entire canal of the fenestra is filled with a compact plug of connective tissue; nevertheless, the labyrinth may still be sound, but the acoustic fibres can be reached only by those vibrations which are transmitted to them through the denser parts, viz. the skull bones.

Up to this time pathological anatomy, clinical experience, the consideration of the nutritive position of the labyrinth, and finally, the reflection that in other organs, especially in the eyes, disturbances of the nervous apparatus are proportionately infrequent—have all taught us that the seat of disease in the ear is far less frequently to be sought in the labyrinth than in the structures which transmit sound. However, this view avails only *salva meliori*, as the lawyers say, *i.e.* so long as we know nothing better, and so long especially as manifold pathologico-anatomical observations, susceptible of proof, do not demonstrate a greater abundance of changes in the inner part of the ear as a reason of the disturbance of the mind.

If there are in addition to the abnormities of the inner ear any changes whatever existing, for instance, in the cavity of the tympanum and the drum, the diagnosis will be still more difficult, for we possess no mark which points certainly and exclusively to an integrity or affection of the nervous apparatus. We shall, in the next chapter, speak of the circumstances attendant on the hearing of a watch, through the bone of the skull, the so-called 'knöckenleitung' conducting power of the bones, the obstructing of which has been denominated a pathognomonic sign of the disease of the labyrinth.

Where a doubt exists whether we have to do with a catarrhal or a nervous difficulty in hearing, whether with disease of the middle or the inner part of the ear, you will do well, in my opinion, in every relation, scientific as well as humane, to consider the first form the more probable one, especially since in this event a proper treatment, in most instances at least, is able to stop the progress of this evil, while real appearances in the inner part of the ear, if not dependent upon anomalies of blood and circulation, are, as a matter of course, almost entirely removed from our therapeutic interference, and we shall be obliged to 'let things go as it pleases God.'"

CASES OF NERVOUS DEAFNESS.

The following cases from Toynbee, on the Diseases of the Ear, will serve to show some of the causes producing nervous deafness, as well as give a review of various diseases under this head:

INJURY TO THE NERVOUS APPARATUS OF THE EAR, PRODUCED BY A BLOW ON THAT ORGAN.

*"A physician in London, while playing with his little children, suddenly brought his right ear in contact with the head of one of them, causing a rather severe concussion on that side of his own head. The concussion was instantly followed by a singing in the ears. I saw the patient soon after the accident, but could detect no unnatural appearance in the membrana tympani; and on carefully testing the hearing power by the watch, there appeared to be no dullness of hearing. This physician has been seen by me from time to time since the accident, and he tells me the singing remains as it was on the day the concussion took place.

The nervous apparatus of the ear is frequently injured also from the effect of a general concussion of the body, in which case the hearing power is often entirely destroyed. The well-known instance of the late Dr. Kitto, who was rendered wholly deaf by a fall from the top of a house when a boy, may be noticed in illustration, and some others follow which have fallen under my own observation."

FATAL DEAFNESS IN THE RIGHT EAR, AND PARTIAL DEAFNESS IN THE LEFT, FOLLOWING A FALL FROM A HORSE.

"The Rev. R. F., aged 53. During many years his hearing has been dull during a cold. Five years before seeing me, he had a

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* Toynbee on the Diseases of the Ear, page 368.

fall from his horse, and the fall was followed by a discharge of blood from the right ear for the space of two days, and subsequently of matter. For some days after the accident, the air whistled out of his right ear whenever the nose was blown. Since the accident, the right ear has been entirely useless, and the left so deaf that he has to be loudly addressed within a yard of that ear. There has also remained a constant singing noise in the head. On inspection, the hearing of the *right ear* was found to have been wholly destroyed, and the membrana tympani presented an orifice, the margins of which were opaque and uneven. *Left ear.*—The membrana tympani was dull on its surface, and in parts calcareous.

In some instances, slight amelioration of the deafness following the accident takes place, as in the next case."

TOTAL DEAFNESS IN THE RIGHT EAR FOLLOWING A FALL FROM A PHAETON; GRADUAL IMPROVEMENT.

"The Rev. J. L., aged 35, had a deafness in the right ear during a cold four years ago. In the same year he fell from a phaeton, and was unconscious for some days. When he recovered his sensibility, he found that there was a hissing sound, like that from a teakettle, in the right ear, which was completely deaf. During two years, however, subsequent to the accident, the power of hearing gradually improved, so that the patient is able to hear a loud voice with that ear. The noises still continue, and are aggravated by wine, or by bodily or mental fatigue; when writing or studying, these noises become overpowering, but in the morning are much lessened. On inspecting the *right ear*, the air is distinctly heard by me to enter the tympanic cavity, but the patient experiences no sensation in the ear when it enters. A loud ticking watch is heard. When spoken to through a trumpet, loudly and slowly, the voice is heard, but not till a second or two after the word has been uttered. The membrana tympani was opaque.

The violent shock communicated to the nervous system of the ear (most probably through the medium of the membrana fenestræ rotundæ) in the act of coughing, sometimes produces deafness; indeed, in some cases, hooping-cough seems rather to cause deafness by this means than by the agency of poison."

NERVOUS SYSTEM OF THE EAR INJURED BY VIOLENT COUGHING.

"Mrs. A. consulted me in 1851, and stated that a week previous to her visit, directly after coughing, she experienced a pain in the left ear, which lasted for two hours, together with a loud singing noise which has never ceased. She complains of an unpleasant sensation as if sounds passed through the ear, and is troubled with a sense of giddiness, and a feeling of confusion in the head. Every step she takes sounds like the beating of a drum. The membrana tympani was fallen in, and its surface dull. The watch was heard only when in contact with the ear. Means having been used to diminish the congestion of the nervous apparatus of the ear, the distressing symptoms of nervousness and giddiness disappeared, but the singing sounds remained.

The concussion upon the nervous system of the ear resulting from loud sounds is a very common cause of deafness. In a previous part of this volume, when speaking of the functions of the ossicles and muscles of the tympanum, it was shown that the one use of the tensor tympani muscle is to render tense the membrane of the fenestra rotunda, as well as that of the larger membrane; and in this tense condition the membrane of the fenestra rotunda is thrown into vibratory movements of much less extent than when it is in a relaxed state. When a loud sound is anticipated, the tensor tympani muscle draws the membrana tympani and the membrana fenestræ rotundæ tense; so that, when the approach of a loud sound is expected, it rarely injures the ear. On the contrary, however, when both membranes are comparatively lax, the same sounds throw them into very extended vibrations, and the fluid in the cochlea by the magnified movements of the membrana fenestræ rotundæ is so concussed as to injure, and often most seriously, the expansion of the auditory nerve in the labyrinth.

Injury to the nervous apparatus of the ear may be produced by a variety of sounds. Cases have been seen by me in which a cannonade at land or sea, or the firing a single cannon, has produced the injury; and others have occurred where an explosion of gas, thunder, a pistol shot, or even loud shouting near the ear, have resulted in the same effect; but the most common cases are those which follow the long-continued sport of shooting, where the deafness almost invariably occurs in the left ear, which is turned towards the gun during its explosion, and consequently receives the direct concussion.

The *treatment* in recent cases where the patient is suffering from the immediate effect of the shock, consists in the removal of the congestion by the application of leeches, or by cupping; by the administration of mild aperients; by strengthening the general nervous system as much as possible, and by securing the ear against the effect of loud sounds."

NOISES IN THE EARS, DEAFNESS, AND A FEELING OF DEADNESS IN THE HEAD, FOLLOWING THE SOUND OF A PISTOL SHOT; RELIEF.

"Mr. C. S., aged 45, a fortnight before consulting me, fired a pistol, for the first time in his life, in the open air on a cold frosty day. The concussion was instantaneously followed by a hissing noise in each ear, but more especially in the right, and he also felt a shock throughout the whole of the head, followed by a 'feeling of deadness' in it. Since the accident, he has been dull of hearing, and has observed, among other things, that he could not hear the 'ring of money.' Leeches and mustard plasters were applied behind the ears, and small doses of calomel and colocynth were administered. Immediate relief to the head and ears followed the application of the leeches, and in a week the hearing had improved, and the noises diminished."

NERVOUS APPARATUS INJURED BY THE REPORT OF A CANNON.

"W. L. C., Esq., aged 73, about four months before consulting me, his hearing being then perfect, was sitting in the open air at Brighton, looking upon the sea, when a cannon near where he sat was fired, without his having any idea of such a proceeding being about to take place. The concussion was immediately followed by a singing in the ears, or rather about two yards from them, and a sensation as if water were rushing through them. Since the accident, he has heard a whisper very distinctly, but a loud voice causes unpleasant jarring sensations in the ears, and deafness to all sounds. In another case, the ear was 'benumbed' for some time after the patient's child had shouted into it."

NERVOUS APPARATUS OF THE EAR INJURED BY VERY LOUD SHOUTING; VERY DISTRESSING NOISES; GREAT RELIEF.

"When surgeon to the St. George's and St. James's Dispensary, a poor man applied to me for relief from deafness and very distressing noises in the left ear. The latter had lasted several years, and the patient, a strong muscular man, thinks they were caused by the loud shouting he is obliged to practice as a hawker of fish. These noises came on in the left ear, and after remaining there some time advanced to the left side of the head; they have increased lately, sometimes resembling 'a rapid tinkling,' at others being like the driving of a sledge hammer; but most commonly they resemble the roaring of the sea. When at their loudest, as after exertion, the house seems to go round with him. The ear is quite insensible to any sound but that of these noises. The right ear is healthy. On examination, the membrana tympani of the affected ear was found to be opaque, and the air passed through the Eustachian tube with a loud crackling. As this was a local affection, as the patient was a strong man, and as the symptoms were increased by any cause which increased a flow of blood to the organ, I determined to treat the case as one of congestion, and accordingly ordered the patient to apply twelve leeches below the ear, followed by a cantharidine cerate dressed with unguentum hydrargyra, at the same time that the outer half of the meatus was washed with a solution of nitrate of silver sufficiently strong to produce desquamation. This was followed by the use of a solution of chloride of zinc (six grains to the ounce) to the meatus, so as to cause a discharge. The result of this treatment was satisfactory. The noises, the patient says, 'have not been so loud or nearly like it:' and ten days subsequently to this report, he said that his head was much better, and 'he could do his work without being obliged to give up.'"

NERVOUS APPARATUS OF THE EAR INJURED BY THE EXPLOSION OF BLADDERS OF GAS.

"J. B., aged 64, was admitted under my care at St. Mary's Hospital in 1853. He stated that nine months previously, directly after the explosion of two bladders of gas at the distance of a yard from his head, he suddenly became so hard of hearing, that he could not hear a voice except when spoken to distinctly at a distance of two yards from the head. The explosion was followed by a singing sound in the ears, which gradually subsided. The watch could not be heard at a distance of more than two inches from the right ear, and only when in contact with the left. The treatment consisted in the application of leeches below the ears, but the patient did not return to report progress.

The following is a well-marked case in which the nervous apparatus was injured by shooting."

DEAFNESS IN THE LEFT EAR FOLLOWING SHOOTING, AND TEMPORARILY INCREASED BY A DAY'S SPORT.

"F. F., Esq., aged 23, accustomed to shoot, has been gradually becoming dull in the left ear. For two years he has not been able to hear general conversation distinctly, and the striking of the clock seems no longer attended by the natural sound. Is more dull of hearing during a cold. Is not aware of any cause that could have produced the deafness. The right ear was in a natural state; by the left the watch was only heard at the distance of half an inch. The treatment consisted in the use of gentle counter-irritants over and around the ear, and in doing all that could be suggested for diminishing local and general congestion. This treatment was followed by great improvement at the end of about three weeks, when the watch could be heard at a distance of four inches—an improvement which continued, with the exception of a considerably increased amount of deafness which ensued upon a morning's shooting. This increased deafness continued for some days, and then gradually diminished. The last time the patient was seen by me, the hearing had not regained the previously improved state, for the watch could only be heard in contact with the ear.

Not having had the opportunity of ascertaining the condition of the ear by the aid of dissection, I have assumed that in these cases, arising from shooting, the nervous system of the ear is defective. The grounds of this conclusion are, that the noises and defective hearing followed *immediately* on the concussion, and all the symptoms indicated that a shock had been given to the nervous system. The *secondary* effect of this concussion, it can scarcely be doubted, may be anchylosis of the stapes to the fenestra ovalis. In cases, indeed, when the nervous system of the ear has received a very severe concussion, and deafness has subsequently slowly came on, I have convinced myself of this anchylosis by dissection, and will now relate one or two cases of the kind."

CONCUSSION OF THE NERVOUS APPARATUS OF THE EAR BY THUNDER; COMPLETE DEAFNESS.

"T. D., aged 80, is so completely deaf that he cannot hear any sound. He states that, fifteen years ago, when in a thunder-storm on the coast of Guinea, he was rendered thoroughly deaf by a clap of thunder, and since then has not heard a sound. On examination, an orifice was observed in each membrana tympani. No treatment was attempted, but about two years after the examination, the opportunity was given me of dissecting his ears, which were in the following morbid condition.

Right ear.—At the posterior part of the membrana tympani was an orifice about two lines in diameter, the remaining portion of the membrane being white, thick, and tense, and more concave externally than natural: parts were also calcareous. In the centre of the remnant of the membrana tympani is a space about half a line in diameter, in which the epidermoid, dermoid, and mucous layers alone remain. The long process of the incus and the crura of the stapes are gone, and the expanded base of the stapes is attached to the fenestra ovalis more firmly than natural. The membranous labyrinth was atrophied, and the nervous fibrillæ of the cochlea appeared the same.

Left ear.—Like the right; except that the crura of the stapes were only partially absorbed.

In another case of total deafness produced by a loud cannonading, the only morbid condition that could be detected by me, on dissection, was that the otoconie was more abundant than natural, while in the vestibule there was a deposit of oval-shaped cells.

Results similar to those noticed as following the practice of shooting, also occur to operatives engaged in occupations involving very loud sounds. Thus in a large factory for making steam-boilers, I found a great number of men engaged in riveting the bolts, and therefore obliged to work inside the boiler, who were very deaf. It will be very interesting to ascertain by post-mortem inspection the pathological condition of the ear when subjected to such loud sounds, and some day perhaps the opportunity will be afforded me of doing so."

THE EFFECT OF THE APPLICATION OF COLD ON THE NERVOUS APPARATUS OF THE EAR.

"There are two classes of cases in which a diminution of the temperature is found to be injurious to the ear: in the one cold air, in the other cold water, is the agent producing the effect. I have known engine-drivers to suffer from deafness after being exposed to a cold blast, and huntsmen also who have had a sudden 'check' when very hot, and have then stood about while a bitter east wind was blowing upon them. The effect of the application of cold seems, in the first instance, to produce congestion; and then to lead to the symptoms of noise in the ear and of deafness, which appear to depend upon a depressed or depraved action, subsequent to and resulting from the congestion. In what the depraved action consists, it is, however, difficult to determine. The congestion often yields to the application of leeches; and the depraved action is frequently diminished, sometimes wholly removed, by the use of gentle counter-irritants, tonics, shower-baths, &c.

The first series of cases consists of those in which the injury followed exposure to cold air."

TOTAL DEAFNESS IN BOTH EARS FOLLOWING EXPOSURE TO COLD BY SLEEPING IN THE OPEN AIR.

"A farm-laborer, aged 28 years, was admitted under my care at the St. George's and St. James's Dispensary, in June, 1850, on account of complete deafness in both ears. He said that eighteen months previously, after sleeping in an open cart in which he was riding in the winter, a usual practice with him, intense pain came on between the right temple and ear, which was relieved by the use of veratrine ointment. About three weeks after the exposure to cold the deafness made its appearance, at first for a day or two only, and then disappeared; in the course of a few days, however, it recurred with increasing intensity and once more disappeared. This recurrence and disappearance of the deafness ended after a few more days in total and permanent loss of hearing. At the present time he cannot hear a gun, even if fired close to the head. He complains of loud noises in the head, and of great heaviness and sleepiness. All kinds of empirical treatment had been tried on him; oils of various kinds had been dropped into the ears, with brandy and salt, and then hot baked salt behind them; every species of medicine had been given, and he had been cupped and blistered at the nape of the neck, but without producing any good effect. On examination, the upper part of each membrana tympani was found to be red, the lower part being concave and white; air entered through the Eustachian tube and caused a loud cracking sound. Some relief to the head-symptoms followed a discharge from each meatus, which was kept up by the application from time to time of the chloride of zinc."

DEAFNESS AND SINGING IN THE EARS FOLLOWING EXPOSURE TO COLD WHILE SKATING.

"J. V., Esq., aged 49, consulted me in March, 1852. His health was good, and his constitution strong. He stated that twelve or fourteen years previously, while skating on a bitterly cold day, a singing sound suddenly came on in the left ear, which has remained ever since; being at times very loud, and then much subdued. A few years after this exposure, the left ear became gradually dull of hearing, and recently both the singing and dullness of hearing have increased. The power of hearing varies, but is not worse after fatigue or excitement. With the right ear the hearing distance was three inches; with the left, half an inch only. Two leeches were ordered to be applied below each ear, and the ears to be syringed with warm water, the object being to remove congestion. This treatment was followed by relief; but with the further progress of the case I am unacquainted.

Two other cases of injury produced by the application of cold air to the ear may be briefly alluded to. The first was that of a gentleman, aged 21, who ten months before my seeing him, being exposed to a very cold February wind blowing in the left ear, had a singing and pulsation ensue within that organ; these sensations are unaccompanied with deafness, and are worse while in bed or reading. At times they wholly disappear. The second case is that of a clergyman, aged 66, who having been exposed to cold in a railway carriage, three years before my seeing him, was subsequently attacked by a whizzing sound in the left ear, which has never ceased. By sitting up late at night, or by entering a warm room from the cold air, the sound is increased, but is better rather than worse after dinner. Complains of dullness of hearing, as general conversation is not heard.

The following are cases where the application of cold water resulted in injury to the ear:—"

DEAFNESS FOLLOWING BATHING IN COLD WATER.

"T. F., aged 19, saw me on account of his deafness. He said, that more than a year previously deafness came on slowly, after bathing daily in cold fresh water, and in a month or six weeks he became as deaf as at present. The affection has been stationary for some months. He requires speaking to loudly within the distance of a yard, and at times suffers from a buzzing in the ears. He is not deafer during a cold, and does not hear better in a carriage. The right ear is rather worse than the left. The previous treatment consisted in dropping oils into the ears, and in syringing them with warm water. In each ear the watch was heard only when in contact. The membrana tympani appeared to be slightly more concave than natural, and its surface was dull and congested. The treatment consisted in the application of a vesicating paper behind each ear, and in taking small doses of blue-pill and iodide of potassium, a treatment which was followed by a slight amelioration of the symptoms."

DEAFNESS PRODUCED IN TWO DAYS BY DIPPING THE HEAD IN COLD WATER.

"A girl, aged 14, the daughter of a farmer, consulted me in 1853. She stated, that two years previously, when very much heated, she plunged her head into cold water, and two days afterwards became so deaf that she required to be loudly spoken to close to the head. The deafness varies slightly, being worse during a cold, and at times, from no assignable cause, better. The treatment consisted in keeping up a slight discharge from the surface of each mastoid process, and in giving small doses of the bichloride of mercury (one-thirtieth of a grain) with gentian, daily. The treatment, pursued during two months, resulted in decided improvement."

DEAFNESS AND NOISES IN THE EARS AFTER BATHING.

"A man, aged 29, was admitted under my care at St. Mary's Hospital, in July, 1853. He said, that six years before, after bathing in a canal of cold fresh water, he became rapidly deaf in both ears, and in the course of a week was so deaf as to require to be distinctly spoken to quite close to him; complained from the first of buzzing noises and pulsations. The deafness and the noises increase in damp weather, or when he is tired; and he also hears worse in a carriage and amid loud sounds. The treatment consisted in the application of gentle counter-irritants over each mastoid process, and in taking alteratives, but without any beneficial effect."

DEAFNESS PRODUCED BY THE ACTION OF MORBID POISONS ON THE NERVOUS APPARATUS OF THE EAR.

"As has been stated, in addition to the causes just detailed, the nervous apparatus of the ear often suffers from the action of the poisons of gout, typhus fever, scarlatina, measles, or mumps. Though unable to furnish any information of the *modus operandi* of the several poisons enumerated, in some cases where the functions of the organ have been wholly destroyed, the nervous apparatus of the ear, on dissection, has been found by me completely disorganized, and the fluid in the cochlea and vestibule dark-colored, and occasionally tinged with blood. Many of the cases of acquired deaf-dumbness originate in the effect of poisons of various kinds. A careful consideration of the symptoms attendant upon these cases, and the results of treatment, indicate that whatever may be the immediate effect of the poison on the nervous tissue, the secondary effect is to produce congestion of that tissue."

NOISES AND DEAFNESS AFTER RHEUMATIC FEVER.

"Miss B., aged 36, consulted me in 1851. She stated, that ten years previously she had an attack of rheumatic fever, which was followed by dullness of hearing in the right ear, and accompanied by a constant whizzing sound and a pulsation which extended over the head. The left ear has lately become dull. The watch was heard only when pressed upon the right ear, or at a distance of six inches from the left. Neither ear presented any appearance of disease, except a slight dullness of the surface of the left membrana tympani. The treatment consisted in applying mustard plasters and stimulating liniments to the nape of the neck, and the etherial solution of cantharides behind the ears. The result of two months' perseverance was such an improvement of the hearing power, that conversation could be more distinctly perceived, and the watch could be heard at half an inch from the right ear."

TOTAL DEAFNESS FOLLOWING AN ATTACK OF RHEUMATIC FEVER.

"Mr. M. G., aged 17, a year and a quarter before consulting me, had a bad attack of rheumatic fever, which was followed by noises in both ears and gradually increasing deafness, so that in a month after the fever he could not hear any sounds. Since the attack, has now and then heard loud sounds for a very short time: but when he saw me he was so deaf that he could not hear anything, even when the poker and tongs were knocked against each other. The ears had been syringed, blistered, and galvanized without any effect. There was no appearance of disease in either ear. The case was at once regarded by me as incurable."

PARTIAL DEAFNESS FOLLOWING AN ATTACK OF TYPHUS FEVER.

"Miss A. M., aged 16, saw me on March 1st, 1851. Eleven years previously she had an attack of typhus fever, and during the illness became so deaf as not to be able to hear the human voice. After the symptoms of fever had disappeared, the power of hearing slowly returned, until she was able to hear when loudly spoken to close to the head. There was no appearance of disease in either ear."

PARTIAL DEAFNESS FOLLOWING FEVER.

"P. A., Esq., aged 49, consulted me in December, 1853. Twenty years before, he had an attack of fever, during and for some time after which he was so deaf as to require to be spoken to close to the ear. The hearing gradually returned, and at the end of two years he heard perfectly well for a very short time, when the deafness as gradually returning, he soon had to be loudly spoken to within a yard of the head. Does not now complain of noises, but has had a tickling sound in the ears. The deafness is *worse* after flurry, excitement, or fatigue, after dinner, wine or beer; a single glass of either of the latter increases the deafness instantaneously. Is *better* after a discharge from the nose, and while riding in a carriage. The hearing power of the left ear is gone. On examination, no unnatural appearance was detected in either ear, and the watch was heard when pressed upon the right ear."

TOTAL DEAFNESS FOLLOWING AN ATTACK OF FEVER.

"Miss C. J., aged 21, when a child had an attack of fever, since which time she has gradually become deaf, and at the present moment cannot hear even a loud clapping of the hands. Five years ago both tonsils were partially removed, and their remnants have recently been snipped, with no effect except that of producing great mental depression. There was no appearance of disease in any part of the organ.

The poison of *scarlet fever* like that of *typhus*, sometimes injures the nervous apparatus of the ear, and not unfrequently complete deafness is the result. The following are illustrative cases."

DULLNESS OF HEARING FOLLOWING AN ATTACK OF SCARLET FEVER.

"Mrs. S., aged 26, had an attack of scarlet fever, eight years previous to consulting me, and since that time has been troubled with a dullness of hearing, especially during a cold. A year ago, after having suffered much trouble, and after being in weakly health, the power of hearing gradually decreased, and this decline was accompanied for the first time by pain, with irritation and discharge in both ears, together with constant noises like the blowing of bellows. Is unable to hear general conversation, but a single voice is heard distinctly. The left ear is worse than the right. On examination of the right ear, the surface of the meatus was found to be dry and to contain small portions of epidermis; the membrana tympani was opaque, and the Eustachian tube pervious. The left ear was in a similar condition."

COMPLETE DEAFNESS IN THE RIGHT EAR PRODUCED BY THE POISON OF SCARLET FEVER.

"Mr. H., aged 20, had an attack of scarlet fever at four years of age, since which time the right ear has been so deaf as not to be able to hear even the slightest sound. On examination, the right membrana tympani was observed to be more opaque than natural, and the left ear was perfect in every respect."

MUMPS.

"The peculiar poison which causes the disease generally known by the name of mumps is very often the source of complete deafness, which, however, usually occurs in one ear only. In these cases, the nervous apparatus is evidently affected, as the deafness comes on suddenly, is usually complete, and, as a general rule, no appearance of disease can be detected in the meatus, membrana tympani, or tympanic cavity. When the nerve is not wholly paralyzed, and some, although it may be a very slight degree of, hearing remains, the only plan of treatment which can be recommended, is the use of gentle counter-irritation over and around the ears, at the same time that the ear is exercised by means of the elastic speaking-tube."

"The poison of *gout* may also give rise to deafness and other peculiar symptoms in the head. In two cases of this affection which came under my notice, it is interesting to observe that the head-symptom complained of, viz., a feeling of vacancy, was at once relieved by pressure upon the air contained in the external meatus."

DISTRESSING SENSATIONS PRODUCED IN THE EAR BY GOUT.

"D. T., Esq., aged 54, consulted me in June, 1857. He said that for the last four or five years he had been subject to attacks of gout, which had at times caused him great inconvenience, and the disease had recently made so much progress as to make him fearful that his brain was weakened by its influence. He added that he was never really clear-headed, excepting just after an attack of gout, when he supposed his blood was temporarily freed from the poison. He had rapidly aged in the course of the previous two years. An extremely distressing symptom had lately presented itself in the form of a peculiar sensation of vacancy in the ears, accompanied sometimes by a low humming sound. There was no deafness, and the patient applied to me only on account of the sensations in the ear. On examination, small deposits of gouty matter were observed in the substance of the right upper eyelid; the surface of the meatus externus was of a bright red color; the circumference of the membrana tympani and of the long process of the malleus were also red; while the surface of the tympanic membrane was very bright. Air passed freely, and with the natural sound, into the tympanic cavity. The hearing power was perfect. By what, therefore, could the distressing symptoms be caused? Were they the result of congestion of the nerve?—a condition which, it seemed to me probable, might render the nerve so exquisitely sensitive, that the ordinary sounds ever floating in the air might become a source of excitement to the ear. Being aware also, from previous experience in similar cases, that pressure upon the external meatus so as to shut out or diminish the sound in the meatus would remove the symptom complained of, I closed with my fingers each external meatus, and the unpleasant symptoms at once disappeared. On subsequently exerting a gentle pressure on the ears by the introduction of cotton steeped in water into each, the patient was enabled to leave in comparative comfort. For the purpose of preventing the recurrence of the symptoms, it was of course requisite to diminish the congestion, for which purpose two leeches were applied below each ear, small doses of colchicum administered, and strict attention to diet enjoined. The quantity of wine was decreased from four to two glasses daily, and in lieu of beef and mutton, of which he had been in the habit of partaking very abundantly, he was ordered to live principally on poultry, game, and fish, with abundance of farinaceous food and vegetables. The result of this treatment was the removal of the distressing symptoms in the ears, and the gradual disappearance of the attacks of gout."

DISEASES IN WHICH THE BRAIN AS WELL AS THE EAR APPEARS TO BE AFFECTED.

DEBILITY OF THE NERVOUS APPARATUS ARISING FROM MENTAL EXCITEMENT.

"A young lady, of about 25 years of age, is brought to me by her mother, on account of deafness in both ears, one being much deafer than the other. The patient is pale, rather thin, and has a look of depression. She complains of humming noises in both ears, and hears better in a carriage. Upon examination her pulse is feebler than natural, and the deafness is so considerable that she requires to be loudly spoken to within a yard of her ears. There is no morbid appearance in any part of the ear, and the Eustachian tube is in a natural state. On inquiring as to the origin of the deafness, the parent states that they had not been able to detect any cause. The deafness came on three years previously, when the young lady was in good health, and gradually increased, till in four months the patient had become as deaf as now. She is rather deafer after excitement and during fatigue. There is no hereditary tendency to deafness. The young lady has remained at home with her mother, has taken plenty of exercise in the open air daily, and retired to bed early; but, for some reason or other, her nervous system was not strong, and she was easily excited. On further questioning, it is found, that about the period when the deafness came on, the patient was particularly nervous, and ultimately it turns out, by her confession, that she had been deeply grieved by the conduct of one of her friends, and had often lain awake at night indulging in sorrow, and that, at such periods, the noises came on in increased force.

Another young lady, aged 19, is brought just after leaving school, where she was well taken care of, and so liked by all, that she even preferred school to home. Her parents stated that six months before, without any apparent cause, their daughter had grown gradually deaf, and can at present hear only when very distinctly spoken to, within a distance of two or three yards. The deafness is worse during excitement. There is no appearance of disease in the ears, and the girl is strong, active, and healthy; her nervous system is, however, very sensitive, her feelings most acute, and she broods in silence over slight mental troubles which would pass unheeded by ordinary persons. Perhaps all attempts to find out the cause of the deafness are in vain; and the parents go away with the assurance from the medical man, that at the time the deafness first appeared there must have been some cause of mental excitement to call it forth. After the lapse of a shorter or longer period, the medical man learns, perhaps, that at the time in question the young lady at school suffered a great deal of mental anxiety, owing to her religious views being in an unsettled state.

These two cases are good types of the class of nervous deafness now under consideration. The causes may be very numerous, and in some instances are but slight, compared with the distressing symptoms which ensue; but it must be borne in mind that, as a general rule, the nervous system has, from a variety of causes, been allowed to sink into a weakened condition. Thus the child may have been overworked, have suffered from indigestion, had too little exercise or not enough sleep; ventilation also may have been defective. In a depressed state of health from any of these causes, an apparently slight additional cause may produce the injurious effect on the nervous system which has been indicated. Sometimes there is no diminution of the hearing power, and the patients complain not of deafness, but rather of singing noises, which are increased by any mental excitement. In some cases the noises are not constant, but only appear after mental emotion; the slightest unpleasant thoughts are sometimes sufficient at once to induce the noises.

The deafness and noises in this class of cases, if slight, can be cured by removing the cause (a depressed state of health), and by giving tone to the nervous system by tonics and by local applications to the ear. In some cases, however, of this species of nervous deafness, the symptoms of noises became so greatly aggravated, that unless their peculiar character had been detailed by several patients, it would be difficult to credit their existence. They may commence with a gentle singing, then increase to a hissing or whizzing sound, that suddenly changes to a series of sharp cracks, like pistol-shots, followed by a rushing sound like the wind, or the escape of steam from a boiler, after which a rolling may ensue like thunder. These sounds vary much in intensity, being increased in some by rainy weather, in others by an easterly wind; bodily fatigue may sometimes cause them to be magnified, but the source of increase is usually some discomfort or excitement of mind. A young lady, for instance, comes into my room with her mother to consult me, and she says that the noises became rather worse than usual when told that she was going to see a medical man; that they were accelerated when entering my house and waiting in the dining-room; and that they reached their acme of intensity after the excitement attendant upon my examination of the ears, and questioning her about the symptoms. The important problem for consideration is, can the ears be improved? So far as my present experience extends, I may say that a large number of the worst cases can be but slightly influenced by treatment; but there is still a large number which may be very greatly benefited by measures calculated to brace the nervous system; as tonics, fresh air, exercise, and mental repose. In these cases I am giving electricity a trial."

DEBILITY OF THE NERVOUS APPARATUS OF THE EAR, PRODUCED BY OVERSTUDY.

"Lady D. brought her child to me in June, 1852. The young lady was twelve years of age, thin, rather tall of her age, and pale. The pulse was weak; the tonsils large and red; the mucous membrane of the fauces red, thick, and rugous. The sub-maxillary glands were somewhat enlarged, and she had been subject to glandular swellings in the neck. The appetite was good, and she partook freely of meat twice daily. She was taught at home with her sister by two governesses, one being for languages. She devoted between eight and nine hours daily to her studies. The history given me was, that during the last two years, without any assignable cause, the power of hearing had gradually diminished, and there had been slight noises in the ears at times. On inquiry, it was elicited that she was greatly interested in her studies, and very anxious to make progress in them, never much tiring of her lessons. Her interest in them increased to excitement, and she was often agitated and distressed at not being able to accomplish as much as she desired. On examining the ears, a slight dullness was observable in each membrana tympani; the Eustachian tubes were pervious, but the hearing power was so diminished, that she required to be loudly spoken to within a yard of the head.

This deafness was at times so greatly aggravated, that considerable difficulty was experienced in making the patient hear at all. It was, therefore, palpable that there was considerable debility of the nervous apparatus of each ear, for which tonics were prescribed, also a gently-stimulating embrocation; fewer hours were to be devoted to study, and light nutritious food, as game, poultry, fish, was to be taken instead of so much meat. All this resulted in some slight amelioration; but still the deafness was very considerable, and increased greatly at times. Under the circumstances, another consultation took place, at which I clearly traced the attacks of increased deafness to more than usual nervous excitement following more than usual mental work. In addition to the previous tonic measures, entire rest from study in any shape was enjoined for three months, during the whole of which time the hearing gradually improved, and at the end of six months the patient was declared to be perfectly well; and, although she has resumed her previous plans of study, moderated according to circumstances, the case remains satisfactory.

To the above case the details of several others might be added, were not a brief allusion sufficient. Thus a lady, aged 27, consults me for deafness accompanied by noises which gradually came on during the previous four years. The nervous system never was strong, but underwent a severe shock, about the commencement of the period mentioned, from the breaking off of a matrimonial engagement. With the continuance of the mental sorrow the deafness and noises had gradually increased, and were always accelerated after much mental objection.

Another lady of nervous temperament and warm feelings, was sitting at home awaiting the return of a brother to whom she was greatly attached, when he was brought home dead from a fall in the street. For the space of a year the sister gave way to despondency, and, as she told me, the thought of her brother during the whole year was scarcely a moment absent from her mind. At the end of that time, as her spirits began to improve, noises appeared in the ears and head, dullness of hearing followed, and both noises and deafness so greatly increased, that in the course of another year, when seen by me, she was so hard of hearing as to require to be loudly addressed at the distance of a yard or two, while the noises had reached a pitch of extraordinary excitement. There was scarcely any conceivable sound, whether of thunder, cannon, firing guns, bells, hissing, rolling of the sea against the beach in a storm, or winds howling, to which this lady was not subject. These sounds intermixed and alternated in a manner quite indescribable. They remained of the same general intensity, varying somewhat according to the weather, for several years; when another severe domestic bereavement occurred, followed by some new noises of a still more intense character, but her deafness remained much the same.

Another lady, who married at about 26 years of age, was subjected to severe domestic trials, which, after preying upon her mind for some years, ended in such total deafness, that she could not hear a pistol-shot fired close to her head.

The variable amount of deafness in this class of cases is sometimes very marked. Thus, I had for a long while a patient under my care who, when perfectly tranquil, could distinctly hear his daughter reading to him at about the distance of a yard; but if his daughter told him anything which excited his interest, he became so thoroughly deaf as not to be able to hear a sound, and would remain so until the excitement vanished, when his hearing would return."

DEBILITY OF THE NERVOUS APPARATUS OF THE EAR PRODUCED BY GENERAL BODILY DEBILITY.

"It is difficult to draw a correct comparison between the number of cases of deafness dependent upon excess of mental excitement, and those arising from overtasking the body; but from the data before me, perhaps those of the class now to be considered are the most common. They occur in both sexes, but are more frequently met with in the female; and present great variety of form as well as cause. Sometimes they are temporary, and produced by a long walk, heated rooms, late hours, &c., when noises, with diminished hearing power, came on, but disappear after rest. Other cases, and even some of those which come on suddenly, may, however, remain more or less permanent. Thus, cases have been met with in my experience, in which patients have become totally deaf after the administration of too violent a purgative, or after an attack of diarrhœa or cholera, and after the nervous exhaustion attendant upon childbirth; in some instances of the latter, the deafness has begun with the birth of the first child, and increased with each successive birth, until at last the nervous power was wholly lost. Perhaps the most common cause of nervous deafness from physical debility is the want of proper care in the management of young persons, and particularly girls, when they are growing fast. In hospital practice, young nursemaids who carry heavy children, and whose night's rest is often disturbed, and youths just entering laborious situations, are found to suffer. Any cause, in fact, which reduces the nervous energy of the body to a state too low for the due regulation of the functions of the various organs of the frame, may be followed by a manifest depression of the nervous power of the ears, which shows itself not merely in diminished power of hearing, but often by singing and other sensations in the ear, and sometimes by severe pain, like tic doloureux. In cases where debility of the nervous system of the ear is the result of a debilitated state of the body, the pulse, as a general rule, is weak, and there are symptoms of previous or present indigestion. Generally, no unhealthy condition of the organ itself is apparent; though, in recent cases, the cerumen may be softer and more abundant than usual, and in old standing cases may even be absent.

The *treatment* of cases of debility of the nervous apparatus of the ear arising from bodily debility, consists in imparting, by every possible means, strength to the general system. Exercise in the open air, a due amount of rest and sleep, well-ventilated rooms by day and night, abundance of nutritious food, stimulants in moderation, tonics in the shape of quinine, bark, strychnine, creosote, &c., should be prescribed; while locally, gentle stimulants should be applied over and around the ear. I have never found the vapor of ether applied to the tympanic cavity by means of the Eustachian catheter of any service; nor has my limited experience of the use of galvanism and electricity hitherto been favorable to their employment. Some cases are decidedly amenable to treatment, and the noises diminish or disappear, while the deafness is greatly diminished; but if the cause in which the deafness originated be allowed to continue, or if any debilitating influence be present, total deafness may ensue in spite of every remedial effort. The following cases are all interesting."

DEAFNESS PRODUCED BY WANT OF SUFFICIENT SLEEP; CURE.

"In the early part of 1855, a young gentleman, aged 14, was brought to me by his father, on account of gradually increasing deafness. He appeared to be in tolerable health, and was at school in the neighborhood of London. No cause could be assigned for the affection, which had so far advanced as to cause him great discomfort from his inability to hear what his masters said to him. On examination, it became apparent that the deafness depended upon debility of the nervous system, for there was no history of any other disease, nor was there any appearance indicative of disease. The patient, had, however, occasional noises in the ears, following over-exertion, and he certainly was deafer when he was tired. On inquiry, I could discover no special cause for the deafness, as he followed the same rules and regulations which were pursued by all the boys in the school. I prescribed internally quinine, and a stimulating liniment externally, giving directions that he should not be over-worked. In a month's time the boy was seen again, but remained in much the same state, so I requested to be allowed to see the lady with whom he boarded, in order to ascertain further particulars as to his mode of living. On the most minute questioning no sufficient cause could be detected, except that, being very desirous to prepare his lessons well, he sat up so late that when the time arrived for getting up, he was so sleepy as to be aroused with difficulty. It was at once rendered probable, that the debility of the nervous apparatus of the ear might be dependent upon the want of sleep; and I therefore requested his friends to see that his duties were so relaxed that he could take as much sleep as he required, and gave directions that he should go to bed at eight o'clock, and sleep until he awoke of his own accord. The result was, that for several successive nights, he slept for fourteen hours, and by degrees the number was reduced to ten, which was his usual allowance for three weeks, at the end of which time he returned to me, when, to the gratification of all, it was found that his hearing was nearly restored, and he was no longer styled 'the deaf boy' at school. The patient has been seen by me twice or thrice since, at considerable intervals, in consequence of the deafness returning; but each time it was evident that the nervous system had been too much exhausted, and the administration of quinine, with less work, and an increase in the amount of sleep, soon restored the hearing."

TOTAL DEAFNESS PRODUCED BY THE NERVOUS SHOCK CONSEQUENT UPON SUCCESSIVE ACCOUCHEMENTS.

"Mrs. B., aged 40, pale, and of a nervous temperament, consulted me in 1850, on account of complete deafness in both ears. She stated that she had married in India ten years previously, and at the time of her marriage she could hear perfectly well. On the occasion of her first confinement, previous to which her hearing was still perfect, she suffered a good deal from exhaustion, and this was followed by a great degree of deafness, so that she could scarcely hear what was said to her, even when the voice was much raised. Upon getting up, and growing stronger, the deafness was so much relieved that she merely required to be spoken to a little louder than usual. During each successive confinement in India, amounting in all to four, the deafness greatly increased, and after each recovery became more permanent, until, on the last occasion, she remained as deaf as at present, when she is obliged to have recourse to signs. Indeed, she has never heard the voices of her younger children, and can only by the movements of their lips understand their words."

DEBILITY OF THE NERVOUS APPARATUS OF THE EAR ARISING FROM OVER-EXHAUSTION IN INDIA.

"Captain T., aged 40, came home from India in 1858, having undergone great fatigue, and his health having been greatly shattered, while his hearing power had so much diminished, that when he consulted me I was obliged to speak very distinctly within a yard of his head. He complained of constant loud singing in the ears, which was increased by the slightest exertion. On examining the ears, no alteration from the normal condition could be detected, and the Eustachian tubes were in a natural state. The treatment consisted in sending the patient to the seaside and in giving him quinine, using at the same time a stimulating liniment over the ears and at the back of the neck. In two months his strength had greatly increased, with a corresponding improvement in the hearing. He returned to the seaside to pursue the treatment in capital spirits, and was induced to go out on two consecutive days to evening parties, at which he stayed till very late. Nervous exhaustion followed, and his hearing sank to the same low ebb as when he first consulted me: nor was it until after two months of very quiet life and steady keeping to the prescribed treatment, that he again began to improve."

NERVOUS DEAFNESS PRODUCED BY OVER-EXERTION.

"E. Clarke, aged 31, a tall muscular carter, was admitted under my care at St. Mary's Hospital, on January 27th, 1859. He stated, that fourteen years before, when out of health, deafness came on in the left ear, accompanied by noises, sometimes like a kettle singing, at others, like the ringing of bells. On recovering his health, he found himself perfectly deaf in the left ear, which has remained so ever since. Eleven weeks ago, when a good deal exhausted by hard work, he took a bad cold, during which singing came on in the right ear, with loud noises, like the ringing of bells, and were accompanied with so serious an amount of deafness, that he required to be spoken to in a loud voice, within a yard of his head. The patient's pulse was weak, and he had a worn aspect, as from exhaustion of the nervous system. On examination, no appearance of disease was visible in either ear, and the Eustachian tubes were pervious. Two grains of quinine were ordered to be taken twice daily, and a stimulating liniment to be rubbed over the surface of the ears, at the back of the neck, and down the spine. In the course of a week the noises decreased greatly, and in a fortnight they had wholly disappeared, while the hearing power gradually increased; so that when he left the hospital, at the end of six weeks, to use his own words, he 'at times hears quite nicely.'

Several cases of a similar character might be cited, in which equally favorable results followed the administration of strychnine, in doses varying from one-thirtieth to one-twentieth of a grain, twice or thrice daily; and in some instances, where neither quinine nor strychnine were of any benefit, doses of creosote, or of morphia, or of both together, were productive of great improvement."

NERVOUS DEAFNESS RELIEVED BY CREOSOTE AND MORPHIA.

"Miss M., aged 29, in good health, but very easily excited, consulted me in January, 1859, on account of deafness. Four years previously her left ear gradually became deaf, accompanied with noises very difficult to describe, but something like a whizzing, and these noises were increased by any external noise, or if she felt nervous, tired, or excited, and were worse at night. In a few months the right ear was also affected in the same way. In both the deafness was gradually increasing. This deafness was also accompanied by a sudden loss of voice after she had spoken a few words. The only cause to which she can ascribe the deafness was the habit of going for many hours without food, and then eating very rapidly. She had been treated by blisters, whose use had been followed by a rapid advance of the deafness. and she had been told that her case was incurable. At the time of her first consulting me, it was requisite to speak loud within a yard of her head, and she was deaf to all general conversation. On examination, each membrana tympani had a perfectly natural appearance, and the Eustachian tubes were healthy. The *treatment* consisted in using gentle counter-irritation over each ear, the back of the neck, and down the spine, and in administering creosote and morphia, in doses of two or three minims of the former to one-twelfth of a grain of the latter, twice daily. This treatment was continued perseveringly for four months, at the same time that every measure for restoring the general health as respects food, exercise, and diet, were resorted to, and at the end of the treatment the hearing power was so greatly improved that she could both hear and take part in general conversation.

Cases of nervous affection of the ear sometimes occur in which the chief symptom is *pain*; the treatment does not differ from that of the last class of cases."

PAIN IN THE LEFT EAR, ACCOMPANIED BY DIMINISHED POWER OF HEARING, FOLLOWING OVER-FATIGUE.

"Miss T., aged 25, pale and not strong, was brought to consult me, in May, 1856, on account of a pain in the left ear; this pain had made its first appearance about a year before, after the patient had undergone considerable fatigue by attending several evening parties in succession, and remaining very late; and the pain was much accelerated by any cause which produced fatigue. The hearing power was very slightly affected; and as the other ear was perfect, no complaint was made respecting the hearing. On examination, the organ appeared to be quite healthy; and feeling that the pain arose from deranged action of the nerve consequent upon debility, quinine was prescribed internally, and mild stimulants applied over the ear and down the spine. This treatment was followed by considerable success, as the pain disappeared in the course of a month, but returned slightly upon the patient having to undergo great fatigue."

CONCUSSIONS.

*"Workmen employed in hammering large iron plates, such as are used in making the boilers of steam-engines, are very apt to lose much of their hearing power. So many of those cases are seen at Ear Infirmaries, that at one time 'Boilermakers' Deafness' figured as a separate disease of the ear in the statistical reports of one of our institutions where aural disease was treated. Examination of such cases has shown me that the lesion causing the impairment of hearing and deafness must be sought for in the labyrinth, and that it is probably due to concussion of the fibres of the nerve in the cochlea and semi-circular canals.

Concussions of the labyrinth, from cannonading, such as are sometimes experienced by soldiers and sailors, the impaired hearing and extreme sensitiveness of the ears sometimes observed in telegraph operators, belong to this class of labyrinth affections. Deafness from such concussions, without an affection of the tympanic cavity, is very rare, however.

There can be no hesitancy in believing that the continual recurrence of a kind of sound, that has no musical, but, on the contrary, an unpleasant character, must at last cause a hyperæmia of the ultimate nerve-fibres of the cochlea. The incessant shock of the drum-head by the blows from dozens or even hundreds of hammers upon vibrating plates must agitate these fibres in such a manner as to finally put them out of tune, as certainly as the constant use of a piano will at last loosen its strings. Clinical experience confirms this view, and my own observations and investigations in reference to boiler-makers' shops seem to demonstrate the following facts:

I. Boiler-makers are nearly all hard of hearing; and those who are not, have, as a rule, taken the wise precaution of plugging the

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* Roosa's Treatise on the Diseases of the Ear, page 508.

external meatus with cotton, so as to diminish the force of the sound-waves upon the drum-head.

II. The impairment of hearing is generally attributable to some lesion of the labyrinth, probably of the cochlea; for the chief symptoms are loss of hearing and tinnitus aurium; there is no vertigo, or staggering in the gait.

Superadded to this serious trouble, tympanic or middle ear catarrh is very frequently present, but these must be regarded as purely coincidental. Boiler-makers are constantly exposed to sudden and marked changes of temperature, and hence often catch cold, intensifying and increasing by this means the aural affection.

Should a man, already suffering from disease of the middle ear, begin to work in a boiler-shop, he will, of course, suffer in a much greater degree, and the organ be more susceptible of additional injury, than a man who is in the enjoyment of a sound organ of hearing. Dr. D. R. Ambrose has shown me a case which confirms this view. In the same way, a telegraph operator who has pharyngeal catarrh, and consequently a swelled Eustachian tube, which is not always capable of performing its proper function, will be more sensitive to, and suffer more acutely from, the concussions of the instrument, than he who has a healthy throat. The existence of tympanic and tubal catarrh will cause the Eustachian passage to be less pervious, or even at times entirely closed; and thus aggravate the unpleasant conditions existing when waves of sound that have to go but a short distance, and are besides inclosed in tubes, and thus increased in intensity, impinge upon the molecules that make up the ultimate fibres of the auditory nerve.

Those who work inside the boilers as riveters, and who thus have shorter waves of sound striking upon their ears, lose their hearing power most completely, as is evidenced by the testimony of all old boiler-makers. It is not easy, in the absence of post-mortem investigations, to define the exact nature of the lesion, but it may probably be a passive congestion of the contents of the cochlea. If care were taken to deaden the sound—that is, to interrupt the vibrations by the use of the cotton plug—I have no doubt but that the hearing power of boiler-makers might be materially preserved. One of the cases already alluded to, which will be given below, is a striking exemplification of what may be accomplished in this respect.*

In studying the cases of boiler-makers' deafness, it will be observed that the subjects of it hear very well in the tremendous din of a boiler-shop, while they are quite deaf in an ordinarily quiet place. It becomes an interesting question as to why this is, or why do any patients with disease of the ear hear better in the midst of noise? These cases, as has been said in the introductory chapter, were first described by Thomas Willis in the seventeenth century, but as yet they have not been adequately explained.

Although the power of hearing the voice is much improved in many partially deaf people—while in a rail-car or stage-coach, for example, or when a drum is beaten near them, as in Willis's case—the power of hearing the watch, or of hearing the outside or general noise, that of the wheels or the engine, is not improved. This fact has not been always appreciated in the study of this subject. The phenomenon of hearing better in the midst of noise also occurs in subacute cases of catarrh, from which complete recovery occurs. This fact has also, I think, not always been recognized in the theories that have been propounded for the explanation of this phenomenon. Relaxation of the drum membranes, rigidity of the base of the stapes, which is the pathological theory at the base of many of these explanations, will hardly be supposed to occur very markedly in sub-acute cases of catarrh of the middle ear."

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* I am indebted to Hon. Robert P. Parrot, of Cold Spring, and Dr. F. D. Lente for the opportunity of seeing these cases.

QUININE.

I FIND many patients, who apply to me for relief from deafness, are of the opinion that the cause of their deafness is owing to having taken too much quinine, but I never have been convinced, save in one or two instances, that quinine had added anything in bringing about such a result. Dr. Roosa says:

*"There is no doubt but that large doses of quinine may cause temporary affections of the labyrinth, which are made known by tinnitus aurium and impairment of hearing. This congestion is not, however, confined to the membranous labyrinth, but it may also occur in the tympanic cavity and in the auditory canal, from the administration of quinine. It is so well known that buzzing in the ear is caused by quinine, that many persons who are becoming gradually deaf from chronic catarrhal or proliferous inflammations of the middle ear, and who, as is the case with most other persons in our country, have taken some quinine in their time, jump at the conclusion that the quinine caused the impairment of hearing from which they suffer. Exact examination often shows that many such patients have never taken quinine enough to cause, or even to cure any disease. I have grown suspicious of quinine, however, in aural disease, in any considerable doses; for I have been convinced by experimental and therapeutical experience that it has a peculiar power of congesting the auditory apparatus. The case on page 155 is an evidence of this fact.

Dr. Hammond published some experiments on this subject in the *Psychological and Medico-Legal Journal*, October, 1874, p. 232, in a paper in which he gives the literature of the subject, and particularly the experience of M. Melier (*Expériences et Observations sur les Propriétés Toxiques du Sulphate de Quinine. Mémoires*

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* Roosa's Treatise on the Ear, page 516.

de l'Académie Royale de Médecine, etc. p. 722). Melier is very decided as to quinine causing deafness, as are other writers; but observations as to the immediate effect of the drug upon the membrana tympani or other parts of the ear do not appear except in the account of Dr. Hammond's own case.

Having myself administered the quinine to Dr. Hammond on that occasion, and noted the results which were published, I was led to repeat the experiments in some other cases. The experiment upon Dr. Hammond was made on the evening of May 7, 1874. The optic papillæ and the membranæ tympanorum were the parts examined, as well as the ocular conjunctivæ and auricles. 'The vision was normal, $\frac{20}{20}$. Refraction, emmetropic; pulse, 90; ocular conjunctivæ white, decidedly free from hyperæmia; palpebræ congested at outer and inner canthus. There was no tinnitus aurium. Membranæ tympanorum were entirely free from evidence of blood-vessels. (I will omit the details of the examination of the optic papillæ, since we are concerned only with the effect of quinine upon the auditory apparatus.)'

Dr. Hammond took gr. x. of sulphate of quinine at 8.30 P. M. At 9 P. M. the ocular conjunctivæ were congested at the outer and inner canthus; palpebræ conjunctivæ were markedly congested over the whole surface. There was no change in appearance of the drum-heads.

'10 P. M. Head feels full; left ear rings; auricles burn; face is decidedly flushed; auricles are red, especially the lobe of right, where there is a localized congestion so marked as to resemble an ecchymosis. There is now a vessel along each malleus. The optic papillæ are pinkish from apparent enlargement of lateral vessels.

'10½ P. M. Right drum-head is very much injected along the handle of the malleus and the upper margin; left is less red, but still shows vascular injection. Both papillæ are pink, left more so than right; face flushed, eyes suffused, ocular conjunctivæ decidedly congested, slight headache, tinnitus in both ears.

'11 P. M. The redness of the auricles is diminishing, especially the circumscribed spot on the lobe of the left one; the face still flushed; tinnitus continues; no headache; subject feels exhilarated; drum-heads still injected along the malleus; vision normal.'

It should be said that Dr. Hammond, the subject of these experiments, is a very large and well-developed man, and that he smoked a mild cigar during the evening.

On the 28th May, 1875, I repeated the experiment upon Dr. E. T. E., æt. 24, a man of about five feet six inches in height, well developed, in good health and vigor. He stated that he never had had otitis. The hearing distance is $\frac{48}{48}$ on each side; refraction, emmetropic. He has no tinnitus aurium. The drum-heads are free from vessels, and normal in appearance; optic papillæ normal. At 11.05 A. M. Dr. E. takes gr. x. of sulphate of quinine. At 11.35 there is a very fine vessel along the right malleus; no change in the left. At 12.30 there is some redness at the periphery of the left drum-head, but the vessel on the right has disappeared. At 1 P. M. the redness has disappeared from both sides. No change is observed in the optic papillæ. There is no tinnitus, and no sense of exhilaration. No tobacco or other stimulant was used during the time of observation.

June 23, 1875.—Dr. C., æt. 25, about five feet nine inches in height, rather spare. Refraction myopic, $\frac{1}{42}$ v.=$\frac{20}{20}$. Drum-heads absolutely free from congestion. No vessel on or along malleus. Optic papillæ are both flushed.

At 10.16 A. M. takes 15 gr. of sulphate of quinine. 11 A. M., a vessel is seen along malleus of right membrana tympani; and left membrana tympani presents no change. There is slight vertigo. 11.30.—There is a sense of heat and tingling over the whole surface of the body. Sense of fullness in ears and head. The handles of both mallei are injected. The hands are tremulous, and the subject gives general evidence of nervous excitement. There are sounds of a high note in the ears. The ears feel warm. At 12.30 the injection of the malleus is disappearing, as are the vertigo and tremor. At 12.50 the mallei are still injected. Motions of the jaw cause peculiar and unpleasant sense of vibration in the ears.

Although these experiments are but three in number, they are sufficient, I think, to justify the view I expressed at the time of publishing a paper upon the 'Diseases of the Internal Ear,' *American Journal of the Medical Sciences*, October, 1874, that the effects of quinine upon the ear were due to congestion. That view was contested at the time of reading the paper,* by Prof. Jacobi, on the ground that some observations that had been made in Germany, as well as clinical experience, seemed to show that anæmia, and not congestion, was one of the effects of the use of quinine; that is to say, it was claimed that contraction and not dilatation of the vessels, was produced by the drug. Dr. Hammond's experiments upon animals, published in the paper from which I have quoted, and, what is much more conclusive than even experiments upon animals, large clinical experience, some of which is given us by such observers as the late Von Graefe,† confirm the view deduced from my observations, that the tinnitus aurium following the use of quinine is the result of overfilled blood-vessels, and is not the anæmia of blood-vessels not containing the normal quality or quantity of fluid.

It should also be stated that I have experimented upon two other physicians, giving each ten grains of quininine at a dose. I have no notes of these cases, but I may say that in one case congestion of the drum-heads and of the optic papillæ followed, with tinnitus aurium, while in the other *absolutely no effect was produced.* The former subject was a full-blooded man who had suffered from congestion of the cerebral meninges. The gentleman upon whom no effect was produced had been in the habit of taking quinine, and was rather anæmic.

The following case was considered to be one of chronic catarrh of the middle ears, with affection of the cochlea. While under treatment it happened to furnish an illustration of the effects of quinine upon the ears:

INJURY OF THE COCHLEA FROM CANNONADING—EFFECTS OF QUININE ON THE EAR.

Dr. P., aged 51. In 1870 was exposed to heavy cannonading, after which he had sudden tinnitus and impairment of hearing on both sides. The symptoms passed away in great measure within a short time. Since then he has had the tinnitus only occasionally. The deafness has not been enough to annoy him until lately. Thinks the right ear has always been the worse. A year and a half ago he noticed that he heard the *click* preceding the striking of his clock, but did not hear the strike. Now he hears the strike but not the click. Hears worse in a noisy place. Has been troubled with irritation and excess of secretion in pharynx for a long time. Health otherwise excellent.

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* N. Y. Society of Neurology and Electrology.

† Archiv fur Ophthalmologie, B. III. 2, p. 396.

H. D.—R. E., $\frac{1}{40}$; L. E., $\frac{5}{40}$. Voice, 50 feet behind back.

Tuning-fork placed on teeth is heard alike. Plugging either ear makes no difference. Placed on forehead or vertex is heard alike, but better on left side when plugged. Placed on mastoid heard better on left side than on right; plugging left ear intensifies sound of fork; plugging the right ear makes no difference. All the notes of the piano are heard well with the left ear. The right ear has partially lost its perception of some of the lower and some of the upper notes, but hears the others well.

Right drum-head: Opaque. Light-spot, narrow and divided.

Left drum-head: Opaque. Good light-spot.

Pharynx catarrhal.

Inflation for three weeks improved the hearing for the watch to $\frac{8}{40}$ on both sides.

One morning, while under treatment, the patient came complaining of great 'stuffiness' and tinnitus in both ears. During the preceding twenty-four hours he had taken 38 grains of quinine for neuralgia. The hearing for the watch was $\frac{1}{40}$ R. E., and $\frac{3}{40}$ L. E. There was intense redness along each malleus-handle. (The day before the hearing had been $\frac{8}{40}$ each side, and no redness of the drum-heads existed on that day, or had ever been seen before.) Inflation did not improve the hearing at all, although it had never failed to do so before. At the next visit the conditions were as usual.

Several weeks after stopping treatment, the hearing had relapsed to its former state.

I believe that the tinnitus aurium and impairment of hearing, following the use of quinine, depend upon congestion of the ultimate fibres of the auditory nerve in the cochlea, and that the redness of the drum-heads is merely an index of the former condition. The peripheric parts of the ear being, however, the only parts open to ocular observation, we must as yet be content with an hypothesis as to the cause of the symptoms of disturbances in the internal ear."

OTALGIA.

There is not, in all probability, in the entire circle of medical practice, a class of diseases respecting which the medical practitioner finds more difficulty in tracing the proximate cause to some determinate seat, than those which appertain to, or involve, the nervous system; and of all the disorders to which the human frame is liable, there are few more afflicting than those painful affections of this part of the system, called *Neuralgia.*

The patients are generally more or less incapacitated for any permanent exertion or employment, consequent to the intensity of the suffering, and the general debility which is thus induced, and also the consequences resulting from the action of the powerful narcotics and sedatives so often had recourse to, to deaden the severity of the agony; these are in many, if not in most cases, urgently called for by the very intensity of the pain.

*"A pure neuralgia of the tympanum seems to occur, though rarely. The best marked instance of it I have seen occurred in a surgeon, aged 36, healthy, and with no diseased teeth. He had been much overworked for three weeks, when he began to suffer from severe pain in the right ear; it came on at night and would last till about three A. M. It affected first the right ear, then the left, and then the right again. It was centred quite in the ear, radiating thence. Hearing not impaired, and no tinnitus; but his own voice, or cough, &c., rang loud and unpleasantly in his ears, although no external sound did so; also he felt the air in his ears whenever he swallowed. During the whole time, whether the pain was present or not, inflating the tympanum would cause pain or even bring on an attack; so that he was afraid to blow his nose.

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* Hinton's Aural Surgery, page 291.

I did not have the opportunity of examining the ears at the time, but some months subsequently, after he had suffered from boils in the meatus, induced apparently by fatigue from railway traveling, I found them quite healthy. He tried quinine and iron without benefit, but lost the pain entirely soon after taking scruple doses of hydrochlorate of ammonia about an hour before its time of access. Three years previously he had had a similar attack pronounced neuralgic by Mr. Toynbee, and ceasing after forty-eight hours at the seaside.

This case suggested to me the use of hydrochlorate of ammonia in scruple doses, in cases of tinnitus that afforded no rational indications for treatment; treating it as a neuralgia, in fact. And though the cases of success are exceptional, I think I can say that I have had more success with it than with any other merely empirical remedy, especially more than with the bromide of potassium, of the efficacy of which I have seen very little, if any, evidence."

PART IX.

UNCLASSIFIED AILMENTS.

TINNITUS AURIUM;

OR,

NOISES IN THE EARS.

THIS distressing symptom has already been dwelt upon at some length as an attendant upon chronic aural catarrh, (see page 176,) but by reason of its great frequency in other affections of the organs of hearing, and as an isolated symptom, I deem it of sufficient importance to appropriate several pages *specially* to the further consideration of this subject by Prof. Turnbull.

*" The ringing noises heard in the ears are not only a symptom of the diseased condition of the organ, but also a very troublesome form of disease in itself, for after all apparent disorder has passed, the patient is still distressed and disturbed by a most persistent form of tinnitus.

Each individual, although suffering from the same symptom, generally describes it according as it is suggested, by his or her habits or occupation. The old lady, fond of her cup of tea, compares the noises to the singing of the boiling kettle; while the servant in the kitchen has a constant ringing of bells in her ears. The engineer will tell you that the noise is like a faint locomotive-whistle; the miller compares it to the whirr of the wheel; while the boiler-maker has a succession of knockings in his ears; the gardener or farmer talks of it as a rustling of leaves, or waving of ripe grain; the sailor, or dweller near the sea, identifies it with the roar of the ocean.

Then we have the agreeable forms, as in an old deaf lady, who informed the writer that she was often serenaded by lovely voices, and would inquire of her children if they did not hear the same sweet sounds. Another pleasant form noticed by a recent writer * was in the case of a middled-aged woman, who spoke of the noise as a low singing of birds.

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*By Laurence Turnbull, Ph. G., M. D. [Reprinted from the Philadelphia Medical Times, June and October, 1874.]

There are some forms which, if neglected, become almost a mental malady, especially if the brain is diseased, or if there is a hereditary tendency in the family, but we have never known a case of suicide from this cause, and our opinion is confirmed in a letter to the writer from Dr. Kirkbride, who for so many years has been the physician-in-chief of the Pennsylvania Hospital for the Insane in Philadelphia: 'I do not now recall a case of insanity really owing to aural disease, although I think that defective hearing often aggravates some of the delusions of the insane, and disorder of the hearing-apparatus is not infrequently in insanity.'

Dr. J. H. Worthingham, physician-in-chief of the Friends' Asylum for the Insane (Twenty-third Ward, Philadelphia), thus writes: 'I never knew a case of mental disorder which owed its existence to such disease (aural), nor any case of suicide in consequence of tinnitus aurium.'

A similar opinion is expressed by Dr. John Curwen, physician-in-chief to the Pennsylvania State Lunatic Hospital, Harrisburg, who had also a long experience as first assistant-physician of the Pennsylvania Hospital for the Insane, at Philadelphia. He writes, 'I do not recollect any cases of insanity under my care which were produced by ear-noises; all the cases of hallucination of hearing have arisen from diseases of the brain, induced in various ways. The three most decided cases now in my care are caused by intemperance and overwork, both mental and bodily, bringing on great cerebral disorder.'

Von Tröltsch,† in his work on the ear, says in regard to the tinnitus aurium of the insane, 'It is a very important question whether the aural hallucinations occurring in insane patients do not frequently depend on peripheric tinnitus, which is exaggerated by the patients.' It would be well worth the trouble of physicians for the insane to examine the ears of such patients. He further states, 'I am indebted to my esteemed friend Prof. L. Meyer, formerly director of the Insane Asylum of Hamburg, for the history of a

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* Dr. Dalby, of London.

† Fifth German edition, p. 515.

melancholic patient who was relieved of a sound in the ear (seeming to the patient to be the cry of a child) by the removal of a plug of inspissated cerumen, which caused deafness of one side. The patient, from that time forward, made a rapid and complete recovery.'

Schwartze, an aural surgeon, and Köppe, a physician for the insane, have made this question a subject of investigation.

Schwartze says, 'Subjective aural sensations, which are caused by demonstrable affections of the ear, may, in predisposed persons, especially when there is hereditary tendency to mental disease, become the direct cause of aural hallucinations, that may accelerate the outbreak of mental disease.' He states that he treated such a patient for a long time, and she was protected from a threatened attack by the local treatment of the aural disease.

Dr. Köppe, before referred to, assistant-physician to the Provincial Insane Asylum at Halle, examined this patient with Dr. Schwartze, and was convinced that the treatment caused the above-mentioned results. In other cases, insane persons who suffer from aural disease distinguish its tinnitus from their illusions or hallucinations. They hear their 'sounds' simultaneously, but independently, of the tinnitus aurium.

Dr. Köppe examined thirty-one insane persons in whom considerable disease of the auditory apparatus could be detected. In none of them was there tinnitus without at the same time the existence of aural illusions and hallucinations.

Seven insane persons also had chronic hyperæmia of the vessels of the handle of the malleus, and, besides the subjective aural sensations, aural illusions and hallucinations. In two cases of inspissated cerumen, the tinnitus disappeared after the removal of the plugs of wax, but the *hallucinations remained.* In several cases, which are fully detailed, both the tinnitus and the hallucinations disappeared after local treatment of the ear. Two cases were particularly interesting, where only one ear was affected, and where the sounds were only heard on that side.*

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* Berliner Klinische Wochenschrift, 1866, Nos. 12, 13,—"Gehorstorungen und Psychosen." Allgem. Zeitschr. fur Psychiatrie, 1867, Bd. xxiv. Auszugsweise im Archiv fur Ohrenheilkunde, B. iii. S. 332.

Tröltsch* again states, 'Perhaps we may designate the one variety as nervous tinnitus aurium, the other as material or acoustic, and which may exist at the same time.'

William Harvey, F. R. C. S.,† mentions hysterical, hypochondriacal, and nervous patients, as suffering from every possible form of tinnitus. Wilde‡ says, 'In some forms of hysteria, and in cases of mental aberration and lunacy, as those familiar with such know full well, the patients often complain of all manner of noises, whisperings, and unnatural sounds, but these are, I believe, generally the result of a disordered imagination, like the ocular spectra which afflict certain individuals.'

Saissy,§ in treating of symptomatic tinnitus, says it depends on 'nervous diseases, such as hysteria, hypochondriasis, convulsions, and mental alienations.'

Dr. O. D. Pomeroy,|| of New York, made an examination of sixty lunatics at the Blackwell's Island Lunatic Asylum, New York, thirty of whom had hallucinations of hearing, and thirty had none, with the view of determining whether diseases of the ear had any agency in the production of the symptoms, and his conclusions were as follows: 'The result of the examination is a little in favor of the hallucination cases being oftener associated with ear-disease. The proportion is not, however, anything like that previously quoted by Von Tröltsch and others.' 'Neither was it possible to observe any connection between the tinnitus aurium and the hallucinations.' Certainly, the aural disease did not, in a single instance, develop or excite the insanity, as has been quoted. This confirms our own examinations and correspondence, and gives a more hopeful and proper view of even the worst form of this affection. Our rule should be that if there is any hereditary tendency to mental disease, and there are persistent hallucinations resembling any of the forms we have given as examples, care should be taken that the ears be examined, and, if it be possible, this symptom removed. We cannot pass from this part of our subject without a

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* Allg. Zeitschr. f. Psych., iii. 332.

† The Ear in Health and Disease, London, 1865, p. 25.

‡ Diseases of the Ear, Philadelphia, 1853, p. 361.

§ An Essay on the Diseases of the Internal Ear. J. A. Saissy, Baltimore, 1829, p. 132.

|| Transactions Am. Otol. Society, Boston, 1874, p. 44.

short reference to the observation made by Nussbaumer, in which he attacks the physiological axiom that each organ of sense is capable of peculiar perceptions, which can be excited by no one of the other organs of sense. 'The author himself, and his older brother, both have this peculiarity, that every perception of sound, either musical or otherwise, excites also a perception of light. His ear is so delicate that with the deep notes of a piano he is able to hear eleven over-tones, and with each one of these has a distinct perception of light. As children, he and his brother were in the habit of designating frequently the tones of different objects when struck, not by the sound, but by the color produced.

'To learn whether the perceptions of the two brothers were always the same, a long series of questions, to be answered by each, was written, from which it seemed that, although each had a perception of light with each sound tried, the color of the light varied: being, for instance, for the note A, in one, dark Prussian blue, and in the other, dark yellow.

'The color was never seen externally, but, as he expressed it, his brain suffered from the action of a sound-wave in the meatus, not only the normal, but also such a change as produced in his consciousness an impression of color. When in concentrated thought, however, the perception of color might escape notice.'

'In the discussion which followed, Prof. Benedict considered that the phenomena were not physiological, but pathological. Optical perceptions, as the direct result of acoustical perceptions, could only be pathological. Similar obscure diseases of the mind and brain were frequently observed in hysterical, hypochondriacal, and melancholy persons, but were not understood, as most physicians were unskilled in psychology. He predicted that similar observations to those of Nussbaumer would soon be reported, now that attention had been called to them. Finally, Prof. Benedict warned the patient against further observations on himself, lest the phenomena would overpower him, especially as it was evident that there was a hereditary tendency; possibly, heterotopia was the cause of the phenomenon.' *

* Report on Otology, by J. O. Greene, M. D., from Nussbaumer. Reprinted from the Boston Med. and Surg. Journal, October, 1873, p. 9. Ueber subjective Farbenempfindungen die durch objective Gehorempfindungen erzeugt werden. Wiener Med. Wochenschrift, Nos. 1, 2, 3, 1873.

THE DIAGNOSIS AND CAUSES OF TINNITUS AURIUM.—The first and most frequent cause we shall notice is the pressing of a portion of altered cerumen upon the membrana tympani. This usually arises from cold, heat, or moisture, or the three combined, detaching it from the side of the auditory canal and causing it to press on the membrane. The second cause is an elongation of the hairs in the external orifice of the auditory canal, passing across and interlacing with cerumen or epithelium scales, and when in the air producing a sound like an Æolian harp. In another form, the point of a single hair was found to rest upon the surface of the membrana tympani. A particle of dried pus on the same membrane gave not only a sound, but a disagreeable one, until removed.

A third cause is a small quantity of adhesive mucus on the inner surface of the membrana tympani, or middle ear, pharyngeal orifice of the Eustachian tube, or on the mucous membrane near the tube. These conditions are almost always an attendant in acute, subacute, or chronic catarrh.

A fourth cause is a foreign body in the Eustachian tube, as, for instance, a beard of barley,* or a bullet.† In the first case, the beard caused otitis media purulenta, with most distressing noises, and was ultimately discharged through a perforation of the membrana tympani without the loss of the hearing, and with entire relief to the tinnitus. The bullet could not be removed. In a case related by Fleischmann, the result was not so satisfactory.

A man complained for years of a continuous sound in his ears and of a very peculiar sensation in his pharynx. He subsequently died, and on a post-mortem section a beard of barley was found projecting from the pharyngeal orifice of the tube, and reaching up into its osseous portion.‡

A fifth cause of tinnitus occurs synchronously with the action of the heart, and may be caused by *anæmia* or a diseased condition of the blood, or enlargement or narrowing of some of the numerous arteries or their branches in the vicinity of the ear. This narrowing occurs generally in a branch of the temporal, posterior auricular, or carotid arteries, and we can determine by pressure whether it depends upon them, after finding no physical cause in the ear itself.

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* Turnbull on Diseases of the Ear, p. 78.

† Ibid., p. 94.

‡ Ibid., p. 79.

A sixth class comprises a large number of doubtful cases, under the head of *nervous tinnitus*, in which it is conjectured that there is inflammation, irritation, extravasation, or disturbed circulation of blood in the labyrinth, cochlea, semicircular canals, auditory nerve, or reflected lesions of the brain.

The diagnosis in this class of cases is made by excluding all causes which would be at all possible to produce the sound in the external or middle ear.

The seventh cause is immoderate contraction of the tensor tympani muscle, which contraction not only moves the malleus and with it the membrana tympani, but also, if the contraction is excessive, draws the whole chain of ossicles inwards, and, as a consequence, the plate of the stirrup is pressed deeply into the oval window (fenestra ovalis), causing violent subjective noises from the intra-labyrinthal pressure. 'Dr. Gruber* observes that the tensor tympani muscle arises from the cartilaginous portion of the Eustachian tube, but is connected with the tensor veli palati muscle by a tendinous prolongation in such a way that the intimate connection between the two is completed; and L. Meyer even asserts that he considers the two muscles as a single diagastric muscle. It is well known how often this muscle suffers in the frequent diseases of the naso-pharyngeal structures. If we notice the soft palate and usually hypertrophied tonsils into which this muscle enters, we will see how the same is displaced and drawn out of its position, and it will be clear that this muscle in such cases is unable to properly perform its function—viz., the opening of the Eustachian tube; and this abnormity, sooner or later, will be sure to affect its companion muscle—the tensor tympani—and so cause the spasmodic contraction of the latter, which will exert a further influence upon the labyrinth.'

I will not speak of the anamnesia, and of the subjective symptoms, which certainly deserve some consideration, but pass at once to those positive signs especially apparent in such cases. In consequence of the peculiar connection between the malleus and the membrana tympani, that is, the lower end of the malleus with the adjacent portion of the membrana, it is directed inwards, while at the upper end the short process pushes it outwards; and there originate two folds, the posterior of which is much more distinct, running backward, while the anterior fold runs forward, and in the comparison of this bulging with the sunken condition of the membrane we have an important indication, which Dr. Gruber was the first to describe and employ in diagnosis.

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* Tenotomy of the Tensor Tympani, by Prof. Joseph Gruber, M. D. Translated by Charles S. Turnbull, M. D., Phila., 1873, p. 23.

When the membrana tympani is drawn forcibly inwards, the lower end of the malleus is drawn with it, while the upper end remains nearer its normal position, so causing the posterior fold of the membrana tympani to become more prominent, and we have at once an abnormal inward bulging of the membrana tympani. Of course, such a condition of the membrana tympani can be produced by causes other than a contraction of the tensor tympani, but we possess very positive means of investigation for distinguishing other abnormities which show the same pathognomonic appearances on the part of the membrana, and by exclusion we can make our diagnosis sure.

Since I have here considered the prominence of the folds of the membrane as a diagnostic symptom of the sunken condition, and as a phenomenon related to shortening of the tendon or the tensor tympani, I might also describe many others which are all caused by shortening of the tendon.

We know how to recognize and appreciate them, and, by a minute examination and some diagnostic acuteness, should seldom remain in doubt.

In this connection, I might mention a few of the symptoms which are here of great diagnostic value, but which, as it seems to me, have not been sufficiently appreciated by my colleagues.

These appearances are as follows: The handle of the malleus appears broader, the membrana tympani is twisted (torquirt sein), the axis-band of the malleus becomes more conspicuous, and the membrana tympani returns more or less rapidly, by retraction, into its former abnormal position, after the application of the air-douche had caused it to bulge outward.

The eighth cause is 'Aspergillus in the auditory canal or on the membrana tympani;' this is a mould or fungus lining the auditory canal and membrana tympani. It causes inflammation and pain with a discharge as in otorrhœa, and, after syringing, of a whitish-yellow membrane which is frequently a complete cast of the external auditory meatus and membrana tympani. In every obstinate case of inflammation of the auditory canal, we should carefully examine the discharged material under the microscope to be certain of the diagnosis. The symptoms are fullness of the ear, constant tinnitus aurium, and pain of a dull heavy character.*

Pathology.—We have noticed, under various causes, that 'tinnitus aurium' results from affections of the external ear, both the anterior and posterior surface of the membrana tympani, cavity of the tympanum (middle ear), and Eustachian tubes, when closed by adhesive secretion or thickening of the mucous membrane, or from the opposite condition of being too open. The noises in the internal ear have also been confounded with an affection of the brain itself or its coverings. It is possible to have ringing noises in the ear even when there are, so far as our examinations can penetrate, no organic changes in any portion of the ear.

In the post-mortem examination of persons who have suffered from 'tinnitus' for a long period without any disease of the middle ear, the appearances found on dissection of the petrous bone by Méniere,† Politzer,‡ Schwartze,§ and Hinton,‖ are disease of the semicircular canals, ecchymoses in the vestibule, hyperæmia of the cochlea, general enlargement and fullness of the vessels of the labyrinth.

We must therefore for the present come to the conclusion that the semicircular canals and vestibule are also the seat of the diseased conditions above described, with now and then apoplexy or endo-labyrinthic fullness of the labyrinth, showing more or less pressure within its walls or irritation of the auditory nerve.

Treatment.—In the first class of cases to which we referred—namely, pressure from cerumen upon the membrana tympani—the treatment in the great majority of cases is simply to remove the offending cause by means of the injection of tepid water or weak solution of soda. Numerous cases of this class are relieved by this simple procedure; many of which are of a most distressing character.

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* See paper by the writer on "Aspergillus," in Transactions Med. Soc. of the State of Pennsylvania, 1873. Diseases of the Ear, pp. 104–7.

† Gazette Med. de Paris, 1861, p. 29.

‡ Archiv des Ohrenheilkunde, vol. ii. p. 88.

§ Ibid., Bd. i. p. 206.

‖ Diseases and Injuries of the Ear, by Dalby, p. 182.

The second variety is caused by excessive growth of stiff hairs in the meatus. The treatment consists in carefully cutting the hairs close up to their point of exit by means of curved scissors, and removing each one when cut. The objection to plucking them out is that it will frequently cause an abscess at the termination of the hair-follicle. Another form of this same variety is when a hair becomes detached and falls upon the membrana tympani, from which it must be removed by means of a camel's-hair pencil slightly moistened in glycerin.

The patient referred to in whom pus from an abscess was washed to the surface of the membrana tympani was a distinguished hospital surgeon, who caused it by attempting to wash out his own ear. When the syringe was properly employed in the hands of another, the pus was removed, and the tinnitus ceased.

The third variety of causes is when adhesive mucus is on the posterior surface of the membrana tympani, in the middle ear, or in the mastoid cells. This is removed by the catheter or a few blasts from Politzer's air-bag or douche; if these means are not effectual, paracentesis of the membrana tympani and washing out the middle ear with a weak solution of biborate or sulphocarbolate of soda in warm water. At the same time attention must be given to the naso-pharyngeal region, with the use of the nasal douche, sprays, and gargles.

In the fourth variety, or foreign bodies in the Eustachian tube, the treatment will be to reverse the action of the air-bag and withdrawing the air, or by means of an elastic catheter in the pharyngeal orifice of the tube, at the same time compressing the nostrils, or by means of a valved bag attached to a curved glass tube introduced through the mouth as near as possible to the orifice of the tube, and rarefying the air. If there be much swelling, thickening of the Eustachian tubes, etc., I have found the Eustachian forceps one of the most valuable instruments in making applications of stimulating agents, such as nitrate of silver, sulphate of copper, iodine, and carbolic acid, directly to the parts.

The annexed figures will illustrate the author's Eustachian forceps (Fig. 32), also the improved rheophore (Fig. 33); the first to make applications by means of a fine piece of sponge charged with the fluid, either by the nose or under the soft palate to the Eustachian tubes. The second apparatus is placed in the auditory canal, which being previously half filled with warm salt-and-water, the metallic wire which projects is insulated by the vulcanite envelope. By means of the metallic screw a connection is made with the conductor of a galvanic or inductive apparatus, and the circuit is closed by placing upon the mastoid process the other moist sponge, which communicates with the second conductor, and the galvanic current impresses not only the muscles but the portio dura nerve by means of a few fascicules of fibres, which constitute what Wrisberg called the 'portio intermedia,' forming a connecting link between the auditory and the facial nerve.

Fig. 32.

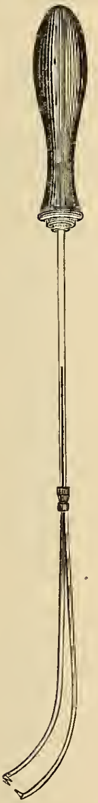
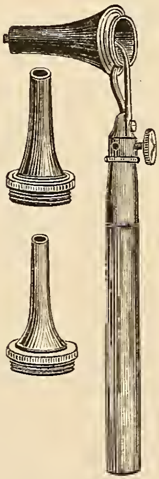


Fig. 33.



Should the foreign body produce inflammation, with effusion, bulging of the membrane, etc., its escape should be facilitated by perforation of the membrane by an aspirator-needle or Prof. Gruber's syringe.

In the fifth form, or pulsating tinnitus, the result of some alteration in the blood-vessels, anæmia, or excessive action of the heart, we must try compression of the temporal or carotid, diminishing the frequency of the heart's action by aconite or digitalis; or, if the patient is anæmic, administer the salts of manganese, or the lactate or citrate of iron, with good nourishing diet and out-door exercise, avoiding all forms of excitement, as dancing, violent exercise, or mental effort.

In the sixth class we must make a careful diagnosis by exclusion to discover whether we have excitement of the brain causing subjective noises, or on the other hand exhaustion of the brain from over-effort or some drain upon the nervous system. For in the first instance we resort to large doses of bromide of potassium, or, if there is any suspicion of syphilitic complication, add the iodide of potassium until we produce bromidism on the one hand or iodidism on the other, with its characteristic cruption.

If it is the second, from exhaustion, we resort to a solution of phosphoric acid employed in the form of a lemonade, or to the phosphites of hypo-phosphites, in conjunction with strychnia or its salts, with the use of the galvanic current to assist in completing the cure.

In the seventh class of cases the operation of tenotomy of the tensor tympani is to be recommended, and the mode of operation is that of Dr. Fr. E. Weber-Liel,* of Berlin, which we have here employed in a number of cases with more or less success, depending upon the cause.

In the eighth class of cases, which are generally the result of a patulous condition of the orifice of the Eustachian tube, the remedy should be the application of a powerful solution of nitrate of silver or sulphate of copper or carbolic acid to the mouth of the tube by means of the Eustachian forceps, and washing it by the use of the double Eustachian catheter, with the internal use of strychnine, to stimulate the muscle to contract and close the orifice.

The ninth class, or 'Aspergillus;' the vegetable parasite or fungus is to removed by the injection of spirits of wine or a warm saturated solution of sulphite of soda, and the discharge of mucus or serous fluid is to be checked by the use of an injection of a strong solution of sulphocarbolate of zinc. A number of these cases of a mild character we have treated after the summer season in patients who have allowed the sea-water to pass into the ears and dampen the hair. In these cases a mild solution of an astringent, acetate of lead or sulphate of zinc, will remove all the symptoms of itching, deafness, and distressing tinnitus, in a very short time."

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*Tenotomy of the Tensor Tympani, by Fr. E. Weber-Liel, Lecturer on Otology, University of Berlin. Translated by Laurence Turnbull, M. D. Pamphlet, pp. 14. J. Moore, Phila., 1873.

RHEUMATIC INFLAMMATION OF THE EAR.

It is but seldom that rheumatism of the ear or its appendages presents itself as a primary disease. The ear in general does not seem to be implicated until after the subsidence of the rheumatic affection of the joints, and sometimes even not until convalescence is somewhat advanced. The patient, after suffering for a longer or shorter time from the usual symptoms indicating a rheumatic attack affecting the larger joints, whether it be or be not the first time that he labours under that disease, begins to suffer from some undefined, unaccustomed sensations about one side of the head. The scalp generally is tender, and sometimes exceedingly painful on pressure, even on the slightest touch of the comb or brush to the hair. The temple on that side, all the parts about the ear, the mastoid process, the neighbouring portion of the cheek, and even the teeth, are the seat of a morbid sensation, with considerable pain; and the patient complains also of a deep, heavy noise in the ear, of a most distressing character. Occasionally the hair falls off, and the patient becomes bald. On making an examination of the ear, the lining membrane of the meatus, and the membrane of the tympanum, are found to be swollen and inflamed, and the latter has lost its transparency. Of course the sense of hearing is more or less impaired. The throat on the same side partakes of the disease; the neighbouring textures are swollen, and of a livid red colour, the inflammation extending up the Eustachian tube. The tonsil on the same side is engaged in the inflammation, causing, with the aid of the diseased condition of the other structures of the throat, considerable pain and difficulty in swallowing. The patient, while suffering from this rheumatic attack, as a matter of course, presents all the symptoms of febrile excitement, the intermission, however, being in some cases so well marked as to cause the fever to resemble an ague.

Dr. William Harvey, Surgeon to the Royal Dispensary for Diseases of the Ear, London, England, was consulted in the summer of 1856, on the case of a young lady, whose symptoms were those of quotidian ague, which had continued for ten days, previous to which she had suffered from a severe attack of rheumatic fever. The cause of the ague was not suspected until the ear became painful, as there were no local circumstances to account for it; but, upon examining the mastoid process, it was found much swollen, very tender, and the patient complained of pain and throbbing in the bone. No doubt being entertained of the existence of an abscess, an incision was made down to the bone, followed by a free discharge of offensive purulent matter, and *an immediate termination of all the aguish symptoms.*

Dr. Griffin, of Dublin, relates a similar case, confirming the somewhat novel doctrine, that ague may depend upon a local cause. The author may here mention a somewhat similar case, to the two above related, that came under his observation during the summer of 1877, in the case of a lady, aged 60, of good family, residing in the southwestern part (malarial district) of this city, who applied to be relieved of distressing pain and noises in her ears, "caused," she said, "by fever and ague." The hearing was also much impaired, and "the fever and ague," which at least simulated the tertian type, still continued. She related she had been afflicted with this fever and ague for several summers, that she had consulted able physicians here and in Philadelphia, and had taken their treatment, but all to no purpose. That she had been advised to go to the seashore, which she did, but only to find her ailment aggravated, as did atmospheric changes. Upon inspection of her ears with a speculum and reflected light, I discovered a dull red, brick-dust color of the meatus and a dryness of the membrana tympani, traversed by numerous vessels, so especially characteristic of rheumatic inflammation. Upon inquiry as to whether she was subject to rheumatic pains in other parts of her body, and being answered in the affirmative, I concluded rheumatism was the primary ailment, and prescribed tinct. of guaiacum with iodide of potassium, and fluid extract of colchicum. This treatment had the desired effect. All symptoms of ague vanished in a few days. The troublesome noises and pain in the ears also subsided, and with the subsidence of the inflammatory action, the hearing was also restored. One year after the patient returned, saying those symptoms had recurred. The same treatment was again prescribed, and with the same happy result, and there has been no recurrence since. In conclusion, then, may we not suspect that rheumatism and ague, both depending upon miasmatic influences, may also be the results of one and the same poison?

When *influenza* assumes an epidemic character, there are some peculiarities connected with its course which are worthy of notice in this place. When influenza sets in during the autumn or winter months, the affection of the throat frequently exhibits a rheumatic character, and the structures of the ear are particularly subject to its aggression.

TREATMENT OF RHEUMATISM IN THE EAR.—This ailment requires, in all its forms and degrees, *constitutional* rather than local treatment. Trifling with and irritating the organ with drops, lotions, &c., is only betraying the patient into a flattering and useless anticipation of benefit, without any chance of eradicating or even of reaching the disease.

Amongst the remedies which I have found most useful in rheumatic affections of the ear, guaiacum holds an important place. Where there is much periosteal tenderness, the iodide of potassium may be added with signal advantage. Colchicum will also be found useful. Pains at night may frequently be much relieved by an embrocation, applied to the nape of the neck, as per the following formula:

℞ Vin. Calch.
Tinct. Aconit. } āā ʒ ij.
Tinct. Opii.
Linim. Sapon., Camp. ℥ j.
♏

This should be applied until the skin is reddened. An occasional purgative, when the skin is hot and the bowels sluggish, is obviously indicated in every stage of the disease. Attention to the skin, by warm baths, in this, as in all diseases of rheumatic, gouty, or neuralgic origin, is of great importance.

CHRONIC CATARRH.

By chronic catarrh we mean a chronic inflammation and thickening of the mucous or lining membranes of the internal organs of the body, such as the nasal passages, throat, bronchial and Eustachian tubes, stomach, intestinal canal, kidneys, bladder, &c., &c. It is usually preceded by an acute stage, with febrile action, though the acute stage is not always well marked. The disease may be confined to a single organ or part, or it may extend to contiguous parts and involve various organs at the same time.

Those of a rheumatic or scrofulous diathesis are most prone to the disease, though it may, and often does, assail those who apparently enjoy good health.

Symptoms.—The symptoms of chronic catarrh will depend upon the organs affected. The general symptoms commonly met with are those of a common cold, acute or chronic, as the case may be, with frequent or permanent obstruction of the nasal passages, with a more or less copious secretion of a mucous or mucu-purulent character discharged from the passages. The obstruction is usually greater in damp than in dry weather, and we not infrequently find that either one passage or the other is nearly wholly impervious to the air, there being no regularity with respect to the nostril affected. The relaxed mucous membrane absorbs the moisture from the atmosphere, and in this way tends to occlude the passage. All affected with this disease take cold easily; scarcely have they recovered from one cold before another will set in, always aggravating the preëxisting catarrh. In simple cases, uncomplicated with fetor of the secretions, there is rarely any ulceration, or even abrasion, of the mucous membrane; but in severe cases this condition prevails, and is usually accompanied with a copious, thick, yellowish, sometimes bloody, and very offensive secretion, causing a bad breath.

Then again in others we find little or no secretion. The patient complains of his nose being dry and "stopped up," not requiring the use of a handkerchief. Where the secretion has been for a long time very abundant, we may expect, on examination, to find a polypus. Nasal polypi are very often overlooked when they are not so large as to be pushed against the external opening by a strong expiration. Sometimes the lining membrane is enormously thickened, so that it may be mistaken for a polypus growth. There is also sometimes loss of smell. Ozena, the most loathsome of all loathsome diseases, here not unfrequently results.

The symptoms of chronic catarrh of the throat are very different in different cases. Often, even in the most intense form, the patient has no idea that he has any affection of the throat. He will, however, just remember, on close questioning, that for years, especially in the morning, he has expectorated considerable quantities of mucus. Others speak of a certain dryness or an unpleasant tickling in the throat, which is very annoying. Others complain of a certain difficulty of swallowing, after the slightest cold, and of various severe pains accompanying it. With these complaints, there is also great annoyance from the constant accumulation of mucus, requiring some considerable trouble in hawking and rasping to remove it from the throat; and the muscles, thus frequently called into service, may be at length forced into morbid action, and vomiting may be produced. This unpleasant symptom occurs generally in the morning just after getting up. As a consequence of the head being on a vertical line with the body during sleep, and the long inaction of the muscles of the throat, a considerable quantity of mucus is collected; this becomes dry and dense, and adheres quite firmly to the membrane. Thus is explained how all the symptoms of catarrh of the throat are most common in the morning, and are the more prominent the longer the patient has slept, the worse the air which he has breathed during the night, and the more he has exposed himself on the evening before—that is, perhaps, smoked and drank. Besides the dryness of the mouth, which is occasioned by such patient by the "cold in the head," and the necessity of sleeping with the mouth opened, which is caused by nasal catarrh, the patient feels also a heaviness and fullness in the ears.

When the bronchial tubes are affected there is more or less cough and mucous expectoration with a feeling of soreness and fullness with a shortness of breath, which is aggravated by active exercise. Very frequently when these parts are severely assailed by this disease, asthma becomes a prominent symptom, and the sufferings of the afflicted are distressing in the extreme. Here too is added the danger of extending to the lungs and developing into consumption.

When catarrh affects the Eustachian tube and the ear (and these organs very seldom escape the ravages of this disease), the hearing *always* suffers, but deafness is not the first indication that this organ has been assailed, but one of the results from its effects. In most instances one of the early symptoms is singing or noises in the ear. These sounds vary in different individuals, and resemble almost all kinds of noises. There is at first little impairment of hearing, but in this I may here say I find patients generally are unaware, even when considerable loss of hearing power has occurred, until their hearing is tested by a watch, the tick of which in all cases should be heard at a distance of not less than 40 inches from the ear. Very many afflicted with this ailment when they apply to me say, "My hearing is not affected; I can hear very well," but when I apply the watch test I find they cannot hear the the tick over 5 or 10 inches from the ear, which others present who are not affected will readily hear over 60 inches away. This dullness of hearing comes on so gradually that it is not noticed until the deafness becomes serious. Another annoying symptom is a feeling of fullness, as if the ear was filled with hardened wax. Sometimes there is earache.

The stomach is not unfrequently affected with catarrh, yet seldom is this fact discovered, but some other ailment is pronounced and the result is wrong treatment and *no* cure. The symptoms of catarrh of the stomach and intestines, are loss of appetite, coated tongue, foul breath, indigestion, despondency of mind, pain in the stomach and bowels and occasional diarrhœa.

When the kidneys and bladder become affected, there is much pain in the back and over the lumbar region, and a burning and smarting with frequent desire to relieve. Catarrh of these organs should always be treated promptly, and not allowed to become chronic, as here this disease soon becomes serious.

The most frequent and important complications are inflammation of the bronchial tubes, lungs, pleura, or of the brain and its membranes, or rheumatism and neuralgia. The cerebral complications are characterized by headache, vertigo, &c.

TREATMENT.—The tendency of this disease, when not properly treated, is to continue with its evil effects increasing as time advances. Much treatment prescribed for the cure of catarrh is entirely worthless, if not positively injurious. I make this assertion from personal knowledge gained from my daily office practice in such cases.

First in importance, in the treatment of this affection, is the observance of good hygienic regulations, as regards food, diet, clothing, cleanliness, and exposure.

Unless the laws of hygiene pertaining to these matters are observed and practically carried out, all treatment will prove inefficient.

The stomach must be kept in order. The food should be nourishing but not stimulating. All indigestible food, and late and heavy suppers, should be avoided. The bowels, kidneys and skin must be kept in a healthy condition, and the body protected from cold by proper clothing. Either extreme of temperature must be guarded against, and especially cold drafts when the body is warm. The feet should be kept warm and dry. Crowded and overheated rooms should be avoided. Internal medication, to be successful, must be regulated according to the requirements of each individual case. If there be a rheumatic diathesis, tinct. of guaiacum in teaspoonful doses, three times a day, will be found useful. Iodide of potassium in doses of three to four grains, three times a day, will also be found efficient here or where there may be a scrofulous taint, in which case is should be combined with some bitter tonic; here, too, cod-liver oil and iron will be found remedies of considerable power.

Where the symptoms indicate cerebral disturbance, the bromide of potassium in large doses will be found an efficient remedy. Where the larynx and bronchial tubes are affected, muriate of ammonia, given in doses of ten grains every four hours, combined with syrup of tolu, or surupus prani virginianæ, I have found to give good results in such cases.

The local treatment for the nostrils and fauces should consist of medicated sprays applied as per illustration on page 196. Astringent, alkaline, iodine and other lotions may be employed through this instrument. Their strength should never be over one grain to four ounces of warm water, and if this strength causes pain or smarting, it should be reduced by adding more water. Astringent gargles should be used where the throat is affected, and it is very seldom it is not, though usually patients are not at all aware of this fact.

DISEASES OF TONSILS AND UVULA REQUIRING OPERATION.

*"Less doubt probably exists in the minds of most persons as to the precise situation and appearance of the tonsils than can be said of almost any other internal organ; placed within easy view at the back of the mouth, and ranged like janitors at the entrances of the two great vital tracts, the respiratory and the alimentary, any disturbance in their normal economy makes itself at once disagreeably evident in the acts of swallowing and breathing.

They are located immediately between the mouth and the musculo-membranous cavity called the pharynx, with which the following passages communicate:—the posterior nares, the Eustachian tubes, the mouth, the gullet, and the windpipe.

All these parts being covered by the same tract of mucous membrane—differing somewhat it is true in its surface characteristics, according to the function of the several passages which it covers—it can readily be supposed that what may be, primarily, simple local affections, are apt, by their continuance, to spread injuriously to neighbouring parts, and such is really the case.

The fact that the tonsils are in intimate relation on their outer side with the internal carotid artery, accounts for the disturbance of cerebral circulation when these glands are enlarged; and this same relation must be borne in mind in all operative measures, for this vessel has more than once been wounded with fatal results in removing the tonsil with the knife, and aneurisms of the carotid have ere this been opened in mistake for an abscess. The position of the tonsils between the anterior and posterior pillars of the fauces should also be carefully studied, as well as the appearance

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* Essays on Ear and Throat Diseases, 1878, by Llewelyn Thomas, M. D., Surgeon to the Central London Throat and Ear Hospital.

of these muscles, since they vary so much in thickness and prominence in different individuals, that in some cases it is extremely difficult to isolate the tonsils from them, the free edges of the muscular pillars *appearing* to blend or run into the substance of the tonsils.

The tonsils assist with the other numerous buccal glands in lubricating the mouth and pharynx, probably chiefly during the passage of food; their functions, however, do not appear to be as important as their size and position would lead us to anticipate, yet their liability to morbid influences is far greater than that of other glands, obviously possessing greater functional activity, as for example the lachrymal gland, which is very rarely attacked by disease.

Considering the liability of the tonsils to be invaded by disease it is somewhat remarkable that they are so rarely the seat of cancer. I have myself only seen three instances; Dr. Tanner states that he had only seen one case, and Dr. Cohen, the well-known American Laryngologist, barely alludes to the subject in his work on Diseases of the Throat. The epithelial form which is by far the most frequent variety of malignant disease in the mouth generally, is seldom seen in the tonsil, which when attacked by cancer is usually the seat of scirrhous or encephaloid disease. Nothing can be done by surgery in such cases, except as an attempt to alleviate the discomforts which the patient undergoes; the galvano-cautery offers the greatest prospect of temporary relief without danger, but no attempts at removal by the knife would be justified, on account of certainly terrible hœmorrhage. Patients with this disease generally complain more of pain in the ears than in the tonsils, and do not as a rule emaciate rapidly, although difficulty in swallowing of an extreme character is the main symptom. Two of the cases, which I have myself seen were both much relieved without hœmorrhage, and with but very trifling pain, by an operation with the galvano-cautery. The one was a case of primary scirrhus of the tonsil, under the care of, and operated on by my colleague, Mr. Lennox Browne, the other was a case of carcinoma of the tongue, extending to the tonsil, which I saw in consultation with Mr. Lloyd, of Bloomsbury. In this case I used the galvano-cautery twice, and with the result that the patient could swallow with much greater ease after each operation. The third case which I was enabled to see at the Brompton Cancer Hospital, by the kindness of Mr. Jeffries, was also a case of primary cancer of the tongue. In both of the secondary cases, the tonsil was at first seen to be quite free from disease, then deposits appeared in the tonsil which broke down, and at last the tonsil became involved in the general mass. This process was well marked in both cases, and the disease did not simply progress by contiguity from the tongue to the tonsil. In all these cases, the friends of patients should be warned, that although there is no apparent danger of an urgent nature, death may occur very suddenly from oedema of the epiglottis or of some other portion of the larynx, or from rapid hœmorrhage.

Abscission of a diseased tonsil,* is doubtless a minor operation,† but like many other so-called procedures, requires some practice for perfection.

In most text books of surgery it is stated that in aggravated cases of enlarged tonsils, they should be removed either with the bistoury and vulsellum, or some form of guillotine; that dangerous bleeding may occur, which is to be stopped by sucking ice or twisting the bleeding vessel, and that fatal cases of hœmorrhage have occurred. Now these instructions though terse, are not very reassuring or definite to a surgeon, who at the request of the patient's friends has consented to undertake an operation which he has possibly never seen performed, and I have lately been consulted by a perplexed friend under such circumstances.

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* "My experience in the treatment of several thousand cases of Diseases of the Throat, extending over a period of five and twenty years, justifies me in saying, that in the whole range of surgery, no operation is so uniformly successful in its results as that for the removal of enlarged tonsils, or rather strictly speaking, *the removal of morbid growths from the tonsils*, for the tonsils themselves, as has been erroneously supposed, are never removed; or at least, there is always sufficient of the gland left to perform the function for which it was originally destined, namely, the secretion of mucus to lubricate the food in its passage to the stomach." *Throat Ailments*, James Yearsley, p. 2, 1867.

† The late Professor Syme speaking of the improvements introduced into modern surgery, said "the operation when properly performed in circumstances really requiring it, affords with perfect safety, such an amount of speedy and permanent relief, as justly to merit the title of a substantial improvement in the practice of surgery."

The questions to be considered are:—1st, what cases require removal, and what cases are sure to receive benefit from the operation? 2ndly, what is the best instrument to use so as to completely encircle and to efficiently remove the tonsil? 3rdly, what are the after dangers of the operation, such as hœmorrhage, and how are they to be avoided or treated?

Any diseased condition of the tonsils or uvula has a direct tendency to affect, as a rule, both the speaking and the singing voice, either temporarily or permanently, and this result may occur either from the mechanical obstruction offered by the enlarged tonsils, or from the direct or reflex irritation which they exert on the mucous membrane of the various passages surrounding them. The influence on the speaking voice of children is most marked and offensive: the child speaks in a thick, muffled voice, and in a slow, drawling manner; these results being in many cases prolonged into adult life, and engendering that peculiar tone of voice which gives one the impression of what I cannot but describe as vulgarity, since we all know the effect that is produced upon our judgment by the first tones of certain voices in regard to the refinement and education of the person with whom we are speaking. In public speakers, if any chronic disease of the throat exist, the voice, even though apparently at the outset little affected, soon becomes weak and dissonant if exercised for any length of time, and the speaker experiences a distressing sense of fatigue, while the audience fail to catch his words at the natural distance.

If the enlarged tonsils grow upwards and backwards, thus interfering with the action of the soft palate and blocking up the posterior nasal apertures, the voice becomes afflicted with a nasal twang, which should not be described as the result of 'speaking *through* the nose,' since the vibration of the air in the nasal cavities is really prevented. In this condition it is very often believed that the patient is suffering from polypus or ulceration in the nose, as the nostril always feels stuffed up, and there may be also a constant discharge. A young lady, aged 15, was recently brought to me with a most disagreeable voice, and an offensive and irritating nasal running; treatment had for some months been entirely directed to the nose, on examination I found that both tonsils were enormously hypertrophied, quite blocking the posterior nares.

They were at once excised and I recommended that treatment for the nose should be deferred to a future day; to the surprise of the friends no further treatment was however required, as the discharge ceased and the voice became almost natural in a fortnight.

The influence of chronic affections of the tonsils on the singing voice is worthy of the most careful consideration, as on a medical opinion may depend the choice of a future career.

One attack of inflammation of the tonsils is always a serious matter for a singer, as it is liable to lead to chronic weakening of the surrounding mucous membrane and to thickening of one or both tonsils, which tend to contract the compass of the voice and decrease its richness, with the possible loss of two or even three of the higher notes. The singer is unable to sing for any length of time with comfort or brilliancy, and feels that the voice is muffled. If the uvula be also affected, there may be repeated attacks of hoarseness from extension of the congestion to the larynx and vocal cords. In cases where the tonsils encroach much on the pharynx the sense of fatigue is probably produced by the efforts of the palatal muscles to drag the tonsils out of the way, especially in the production of the higher notes.

There is a great objection on the part of most singers to submit to any operation on the throat, and the feeling can be easily understood, yet many most eminent singers * have undergone the opera-

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* "For the consolation of those who suffer from enlarged tonsils and are deterred from having them removed by fear of the voice being injured, it may be mentioned that many of our greatest singers, from Madame Patti downwards, have undergone the operation with the greatest comfort to themselves and with the result of increasing rather than diminishing the range of the voice."

"*Medical Hints on the Singing Voice*," p. 30, by Lennox Browne.

"In 1849, Miss Louisa Payne came to me in great distress of mind from the loss of her voice, arising from the condition of her throat, which, for a year or two, had troubled her, and which then appeared so hopeless of remedy, that she had resolved on *relinquishing her profession.* The tonsil on one side was enlarged, and the mucous membrane in its vicinity in a state of congestion. From large experience in similar cases, I could at once charge the diseased gland with much of the annoyance to which my young patient had been so subject. All thickening was removed by the knife, and from that day she improved in health; the throat assumed a healthy appearance, the voice regained its power and improved in quality, in the latter respect to such a degree that its equal has rarely been met with."

Yearsley, loc. cit., p. 100, 1867.

tion with the greatest advantage to their voices. One of the most successful of the Royal Academy pupils consulted me last year, much depressed in spirits, as she was unable to sing without daily increasing fatigue, and she was constantly becoming hoarse; her tonsils were greatly enlarged but she refused to allow any operation as several friends assured her that she would if operated on, lose her voice. She ultimately returned to me and said that it was impossible for her to continue singing in public, and that therefore she would submit to any operation, but at the same time expressed her conviction that she must abandon her profession. She was, however, able to accept and fulfill a public engagement within twelve days of the operation, and has subsequently and with great success carried out many most arduous London and provincial engagements.

Slight affections of the ear in connection with a diseased throat frequently cause a singer to 'sing flat.' The origin of this is generally overlooked, the individual being also not infrequently unaware of the defect.

The evil results produced by diseased tonsils are most marked in childhood, and are the more important as they have such a serious effect on the child's after life, and they may be enumerated as follows:—

Deafness from Eustachian catarrh and obstruction, possibly leading to tympanic abscess; impaired freedom of the passage of air to the lungs; defective nasal respiration, causing the child to snore, to sleep with the mouth open, and the rest to be uneasy and disturbed; in bad cases it may be broken by alarming paroxysms of dyspnœa. This interference with the functions of respiration stunts the general growth, and prevents the due development of the chest and expansion of the lungs; nor are these imaginary evils, as it is common to find in a family that one or two children who suffer with enlarged tonsils are smaller and less developed than the others, though they may be actually the elder. In such a case it will be surprising how after an operation they will regain their health and rapidly pick up their arrested development.

Chronic enlargement of the tonsils is mentioned by Dr. Walshe as a cause of 'acquired collapse of the lungs.'*

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* "*Diseases of the Lungs,*" Dr. Walshe, 3rd Edition, p. 320.

As previously mentioned it is also probable that the pressure of enlarged tonsils acts injuriously on the circulation of the blood through the brain and thus interferes with the general physical development. The digestion and appetite are both impaired by the constant swallowing of the morbid and often offensive secretions from the tonsils, and the passage of the inspired air over this diseased surface hinders healthy aëration of the lungs. In many neglected cases, especially where there is deafness, the countenance is quite characteristic, from the mouth being always half open, by which it acquires a dull vacant expression quickly disappearing after operation if proper attention be paid to the organs of hearing. Distressing cough is often present, especially if the uvula be also relaxed, and a so-called 'weak chest,' might often be remedied by due attention to the throat.

The influence of these glands on the health of children is certainly frequently overlooked, and I constantly see cases which have been attending for months at various Hospitals, taking pints of iron mixture and cod liver oil without benefit, which rapidly pick up strength and development after the operation, and lose their coughs and colds equally expeditiously. In private practice I also often meet with children who have undergone a course of homœopathic medicines in the unavailing hope that these masses of new and diseased tissues may be thus painlessly melted away.

There appears to have existed some years ago—before aural surgery had received the scientific research and investigation which it so seriously demands—an idea that the mere fact of removing portions of the tonsils or uvula would have some mysterious effect in the treatment of deafness. This reckless procedure of necessity tended to bring these operations into discredit and even encouraged some writers to go to the other extreme and condemn them altogether, unfairly basing their opposition on the unsuccessful cases which came under their notice without considering whether there had been any reasonable ground for undertaking the operation at the outset.

These operations have been performed says Mr. Toynbee * in every possible variety of deafness, from cases where the disease has

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* *Medical Times and Gazette*, 1853.

evidently been in the brain or labyrinth, or where the nervous system of the ear has partaken of the general debility of the system, down to those of hypertrophy of the membrana tympani; indeed, it was only requisite for a patient to be deaf, in order to secure the excision of his tonsils, or some part at least of his throat being cut.

Mr. Harvey, who enjoyed considerable reputation as an aurist, violently and indiscriminately opposed any operation on the enlarged tonsils, but he argued as though it were supposed that the tonsils were the sole cause of the deafness, and that their removal, *per se*, was expected immediately to restore hearing, without any further treatment. Mr. Harvey also conjured up many chimerical evils, as the result of operation, which I can honestly say I have never witnessed among the several hundred cases on which I have operated.

Operations for removal of diseased tonsils should never be performed with the intention of remedying deafness, without first ascertaining that the hearing can be improved by inflation or other less severe measures.

As a case in point, a child of four years was recently brought to me from the country, and the parents requested me to do some operation on the tonsils as the child could not speak; I found the tonsils certainly much enlarged, but the child was also suffering from infantile paralysis, and I believed her to be also an idiot; she was not deaf, but she had never even said 'mama.' I refused to interfere, and sent the case to Dr. Langdon Down, whose experience in such cases is well known. Dr. Down confirmed my opinion, and informed me that the child's want of cerebral development would prevent it ever uttering more than a few words. Had I operated in this case the child's physical condition would probably have improved, but the parents would have naturally also expected some attempt at speech as a result, since they refused to consider the child an idiot, its manners and appearance being very pleasing.

The flattened tonsils of French authors, which project backwards into the pharynx and between the pillars, are also a fertile source of trouble especially as a cause of deafness, yet they frequently escape detection. Much trouble has been taken to prove that enlarged tonsils do not directly block up the Eustachian tubes, this is undoubtedly true anatomically, but they push the soft palate upwards and backwards and thus press the anterior lip of the Eustachian tube against the posterior. They also—if not actually themselves, constantly the seat of acute inflammations and abscesses—serve to keep up chronic congestion of the pharynx in the neighbourhood of the Eustachian tubes, and in addition prevent the normal action of the muscles of the soft palate, so important for the due performance of the functions of these tubes. Enlarged tonsils may be generally described as a disease of infancy and youth; it is probable also that some infants are born with diseased tonsils, and though I am not quite sure on this head, it is certain that within a few weeks of birth in scrofulous and weakly children the tonsils may be so enlarged as to seriously interfere with respiration. The first catarrhs of infancy often result in enlargement of these glands, and this hypertrophy becomes later a fixed disease on the advent of scarlet fever, or measles. The eruptive fevers commonly leave the tonsils congested and very liable to repeated attacks of inflammation, and it is in such cases where constant colds and throat attacks occur in childhood that so much valuable time is wasted in attempts to cure the diseased glands by medicine, gargles, and caustics.*

The chief predisposing causes of chronic enlargement of the tonsils are the strumous diathesis, and hereditary specific disease; and to a certain extent the influence of youth must be taken into consideration, as it is before adult life is reached that tonsillar diseases are most frequent, and it is in early life that the glandular system is in its greatest state of activity and therefore most prone to the reception of disturbing influences. The strumous diathesis is a most important factor in the production of enlargement of the tonsils; and in scrofulous children who are constantly suffering from derangements of the cutaneous and mucous surfaces, with ophthalmia, styes, ear-ache, enlarged cervical glands, and catarrhs, it will nearly always be found that the tonsils are enlarged, and this enlargement will probably do more harm to the child's general health and nutrition than any or all of the other complaints.

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* "When the disease is recent and the enlargement is soft, this (local) treatment may prove serviceable in some cases; but more frequently, even under these circumstances, the effect of the applications has been in my experience, *to increase, rather than to diminish the morbid growths*; and when induration has occurred, as the result of a deposition of textural matter, the employment of any or of all the ordinary topical measures will prove entirely futile. Consequently for a number of years I have been accustomed to practise excision in the treatment of enlarged and indurated tonsils, whenever this operation could, with propriety, be performed."

On diseases of the air passages, by Dr. Horace Green, 4th Edition, New York, 1858.

The exciting causes of enlargement are climate—especially the English climate with its constant variations of temperature—and cold in its many forms whether producing constantly recurring catarrhs in the throat or acute tonsillitis (quinsy) with or without the formation of pus. Influenza and the eruptive fevers, smallpox, scarlet fever, and measles; the two latter are particularly active factors of this affection, and in the case of children who are not obviously scrofulous it is the common remark of the parents, that the child was quite healthy and had nothing wrong with its throat or breathing till it had measles or scarlet fever. On the other hand most observers agree that scarlet fever, and it may be added diphtheria, are much more serious and fatal when occurring in patients who are the subjects of enlarged tonsils. Dyspepsia is also a common cause of an irritable inflamed pharynx with tonsillar disease, while diseased tonsils often produce stomach derangement, with loss of appetite and nausea, through the agency of the diseased and offensive secretions poured out by the affected glands.

The hypertrophy of the tonsils, frequently resulting from specific ulceration, should never be operated upon, as it will always yield to treatment, but if it is known that the tonsils were previously diseased, they should be excised when the ulceration has healed, as otherwise the throat will be constantly liable to severe specific manifestations.

No operation on the tonsil should be undertaken during the existence of specific ulceration, however urgent the symptoms, or the result will be a large specific sore, very difficult to heal.

A case of this kind occurred to me lately, a young man who had consulted me three years ago for enormously hypertrophied tonsils, which he refused to have operated on, was sent to me for a recent attack of specific ulceration by his private attendant; he was unable to swallow anything but liquids, was in great pain, and had swelling and stiffness in the neck; he now begged me to remove them, or do anything to relieve him, but I was compelled to wait for several days till the ulceration had been healed by nitrate of silver. They were then excised, to his immense relief, and he now states that he has not felt so comfortable in his throat for years.

The cases likely to be benefited by an operation, are probably much more numerous and varied than is generally recognised in England, though American and many Continental surgeons are fully aware of the fact that it is not by any means the largest tonsils which produce the most trouble, especially in adults. One of the most troublesome forms of throat affection with which I am acquainted, is that produced by the small irritable looking tonsil, with small pellets of cheesy looking matter exuding from the crypts *occasionally*, and associated with a relaxed condition of the pharynx. These tonsils are frequently to be seen in the cases of so-called 'clergyman's sore throat,' and at the first glance into the throat, the tonsils may not appear much in fault, but if the finger is pressed gently on the root of the tongue, so that a slight effort at vomiting is produced, the tonsils will at once be brought prominently into view; their removal in such cases, braces up the whole mucous membrane, removes a focus of disease, and arrests that constant desire to clear the throat which had previously been a source of annoyance and distress in public speaking. I operated last year on a clergyman, whose congregation had subscribed to send him home from Melbourne, for treatment of a throat affection; after the operation he took six months' duty in England to test the result, and on his visiting me previous to his return, he assured me that the impediment in the throat had in no way since troubled him.

Polyps of the tonsils are occasionally met with, projecting from one of the crypts; they are of little importance and are probably the result of some previous attack of tonsillitis; they occasion a slight feeling of discomfort with perhaps an inclination to swallow somewhat frequently. I have removed them by drawing the growth out of the tonsil and dividing the pedicle either with scissors or the wire loop; there is no hœmorrhage and as a rule no recurrence.

Calcareous concretions may be found in the various buccal glands and in the tonsils they frequently resemble the growth of coral, having a branched arrangement; they occasion generally some inconvenience in swallowing and are sometimes to be felt projecting beyond the surface of the tonsil; they may be simply withdrawn with forceps, but generally an incision must be made to allow of their removal, or if the tonsil is much diseased it may be the simplest plan to remove the affected mass containing the calculus. Cysts in the tonsil with fluid or cheesy contents are met with in the tonsil; they are apt to refill after incision, should this happen, the blade of the guillotine should be passed through the middle of the cyst, and the nitrate of silver applied to the exposed surface.

It occasionally happens that in cases of cleft palate there is considerable enlargement of the tonsils, and in such cases Mr. Francis Mason,* with great reason considers 'that their removal is very desirable, because they hinder the prospect of union.'

With regard to the second question, how may the enlarged portion of the tonsil be best removed? There are several methods, three of which I have employed myself and only one of which would I again advocate for general use. A very large tonsil may be removed at one sweep with a curved bistoury, but this implies that the gland should be first fixed, and drawn forwards, either by hook or vulsellum forceps, which procedure necessitates the use of two instruments; generally several repeated cuts are required, and the operation may be complicated by possible dangerous wounding of arteries or muscles. It is to be hoped that few surgeons still use the bistoury, for it cannot be considered otherwise than a barbarous and cruel method in view of the expedition and safety of the more modern method by means of a simple guillotine. Dr. Turnbull of Philadelphia, well remarks in his able work on 'Diseases of the Ear,' when describing what must frequently happen to the unfortunate patient when subjected to the bistoury, that 'in operating with the knife, the child sometimes tears himself loose after the section has been begun, with a scrap of tonsil hanging down in his throat.'

Destruction of a diseased tonsil or uvula by any powerful caustic, always of necessity applied at repeated sittings, cannot be too strongly deprecated in the interests of the patient, and I am sure no patient would submit to such a procedure if he knew the incompleteness of result, and the pain and tediousness of the process as compared with the accuracy and trifling inconvenience or pain produced by the operation he probably so much dreaded.

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* *On Hare-lip and Cleft Palate*, p. 77, Churchill, London, 1877.

Attempts have been made to reduce the size of the tonsils by injecting various fluids into their substance, another measure which can be only described as most unsatisfactory in every way.

Electrolysis has also been brought to bear upon the tonsils, with but small success. Dr. Cohen of Philadelphia, in his work on Diseases of the Throat says that a number of operations—ten to twenty—are necessary, for the removal of the glands by electrolysis and in some of his cases the results were not worth the trouble of the performance.

Another method of removal by the galvano-cautery wire loop, (which is eminently valuable in many somewhat similar cases), may be here dismissed as being unnecessarily cumbersome and not so accurate in its results as the guillotine; the same may be said of the wire ecraseur, except in those very rare cases in which the tonsil is so large that it cannot be embraced by the guillotine.

Complicated guillotines, which attempt to do too much and to supplement the skill of the surgeon are to be avoided, since the surgeon should trust to himself and not to any automatic action of his instrument. These guillotines have three distinct actions, all of which must be in perfect order or the operation is a failure. It must be also remarked that the instruments have to be 'set' according to the amount of the tonsil which it is considered necessary to remove; they also require most careful cleansing and have to be separated into many pieces, as a particle of blood or rust stops their working most efficaciously.

There are many varieties of more or less complicated guillotines, French, German and American, which it is unnecessary to specify by name.

I now come to the description of a simple guillotine,* by which if its action be well understood, one is enabled to perform an elegant and perfect operation almost without possibility of failure. It consists of two blades, running upon each other, the lower is grooved, and constructed with a ring at the extremity for the reception of the tonsil, while the upper or cutting blade, is pushed along the groove by the *thumb* of the operator; a roughened handle six inches in length, is inserted into the lower blade at rather more than a right angle. Some instruments are made with a changeable handle, so that both tonsils may be operated on by the *right hand*; I believe this to be quite unnecessary, as a loss of time is incurred in changing, which gives the patient, especially a child, time to become unruly; any surgeon whether ambidexter or not, can in reality easily push the blade down with his left thumb, such action not requiring any special delicacy of touch.

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* "A writer in the *Revue de Therapeutique Medico Chirurgicale* gives a strong preference to the employment of the guillotine over the bistoury, because of the inutility of the removal of large portions and the less liability to accidents. In support of the necessity for operating speedily in certain cases, a melancholy instance is given from the practice of the writer in which the patient, a girl of sixteen years, suffering from angina with great enlargement of tonsils, literally *died from asphyxia*, from excision being deferred, at the instance of a colleague, *who thought hæmorrhage* would be very severe and that the case would speedily get well if left alone."—Editorial article, *Lancet*, April 3rd, '75.

An instrument has been devised with two guillotines united, to remove both tonsils at once; theoretically, this is an improvement, practically, it is not so, as it is rare to find both tonsils equally enlarged, and it is almost impossible for the assistant to make them project into the throat an equal distance simultaneously. It is also possible to do the operation so rapidly on alternate sides, that the patient has barely time to close the mouth between the removal of the instrument from the one side and the re-introduction on the other. With regard to the operation, it is quite unnecessary to give an anœsthetic even in the case of the most unruly child, *provided the parents leave the room.* In Erichsen's Surgery p. 569, it is stated 'in performing this operation it is best for the surgeon to stand behind the patient, more particularly in excising the right tonsil, as he can thus look better into the mouth and have more command over the head.' This is also unnecessary, and another waste of time, and I cannot understand why it is more necessary for the right than the left tonsil? If sun light be employed both tonsils can be seen equally well; with light reflected from a mirror on the forehead, which is both more convenient and certain, both tonsils can be still better observed.

The great secret of the operation, which does not appear to be generally recognised, is to have the patient's head *immovably* held by an instructed assistant, who may be either a hospital porter, a nurse, or one's own servant, who should firmly press with the middle finger on each side *behind the angle* of the jaw, so that the tonsil is made to project into the mouth, and any required amount of the tonsil may be thus removed without danger of wounding the soft pillars. This manœuvre obviates the use of the complicated forks of the Continental and American guillotines, or the painful drawing out of the tonsils by the vulsellum forceps or hook. In the case of very unruly children it is occasionally necessary to introduce the index finger of the disengaged hand to fix the instrument and feel that the tonsil is really projecting through the ring, and the tonsil may then safely be removed without even seeing it. Immediately the section is made, the guillotine is removed in the horizontal position, bearing the tonsil with it, which should be rapidly disengaged and the instrument, if necessary, re-introduced before the patient has time to close the mouth. Should a child close its mouth obstinately, as sometimes happens, the nostrils should be compressed, and the mouth will be immediately opened. The child, as a rule, is so taken by surprise that there is no difficulty. No gags, as are sometimes advocated, are necessary, the instrument itself acting as an efficient gag.

Adults frequently ask for time to breathe or spit; do not allow it, as the flow of blood obscures the second tonsil, and tends to render the patient alarmed and nervous. Adults frequently say that the assistant caused more pain by his pressure, than the operator, and that the operation is actually not so disagreeable as being painted with nitrate of silver or other caustics. The blade should not be pushed home till the tonsil well projects through the ring, and if any portion of the palato-glossus projects with the tonsil, it is better to remove the instrument and re-introduce it. Any wound of the soft palate produces great after pain, the resulting sore much retarding the healing of the part, and a wound of the muscles of the fauces in the case of a vocalist would be very likely to impair the voice, especially in the higher notes. Signor Garcia once honoured me by attending an operation on a favourite pupil, as I afterwards learnt from the patient, to see that I did not interfere with the pillars of the fauces, and he is undoubtedly right in his idea, that any wound of the muscles acting on the soft palate is likely to prove very injurious to the voice.

On every account it may be asserted that if both tonsils require operation, they should be operated on at the same sitting; by so doing, a second shock is avoided, and the difficulty of swallowing after operation on one tonsil is the same as after removal of both, while prolonging the affair is only cruel to the patient; this is mentioned, since even medical attendants may be induced to compromise matters, by telling patients that only one side shall be cut at a time.

It is frequently urged by patients, and with some show of reason, that it cannot be right to remove the tonsils, as they of course are intended to perform some important function, and people often exclaim 'what am I to do without my tonsil?' The tonsils themselves are not removed, but only the diseased and projecting portions which consist almost entirely of new growth, and that of a very low organization. The new tissue is furnished by successive deposits of fibrine, which are thrown out during the inflammatory periods and become gradually but imperfectly organised, as is proved by their slight sensibility and vascularity, and by the fact that the larger the tonsils, the less pain and bleeding occur during their removal. I have frequently removed immense growths, which actually met in the middle of the mouth, with the loss of but a few drops of blood; the tonsils in these cases were pale and flabby, with large blue veins ramifying over them in the mucous membrane; such large growths might well inspire a surgeon, unaccustomed to the operation, with a fear of serious hœmorrhage. The secreting portion of the gland after the operation, is left hidden between the pillars of the fauces, and continues its proper function of lubrication during deglutition. The tonsils in a perfectly healthy subject ought not to be seen projecting into the throat and in a few weeks after a neatly performed operation it becomes very difficult to determine that any excision has taken place.

With regard to hœmorrhage, though it is often abundant for the first minute, I have never known it to give any real trouble, by adopting the following treatment; immediately after the operation, let the patient *slowly swallow*, a saturated solution of tannin,* *freshly made*, and in a few minutes every trace of bleeding will have disappeared. Tannin may not be quite so powerful a styptic as perchloride of iron, but it is far more cleanly and agreeable, and does not conceal the bleeding spot with a black coagulated mass, as does the iron; after the use of tannin, the tonsils are seen to be coated with a delicate pink film of coagulated fibrine.

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* I have in another paper advocated the use of tannin in preference to iron in general, aural, and obstetric surgery.

Fatal and dangerous instances of hœmorrhage have I believe only happened in cases where the bistoury had been used, and where the parts surrounding the tonsil had been cut, which should never happen if the guillotine is employed. It may occur to the lot of anyone to meet with a case of the hœmorrhagic diathesis, such an one came under my notice lately. I had made a very small incision into a tonsillar abscess, without any important bleeding taking place, the man however returned next day, having as he said, lost a considerable quantity of blood. A large black distended swelling occupied the site of the tonsil, from which blood was oozing *external* to my small incision; I passed in a probe, but nothing but blood issued, and I discovered that it was the abscess cavity, distended with blood, which had filled and pointed in a new place, blood continued to discharge for five days, which was always kept in check by strong tannin solution, and ultimately the sac of the abscess discharged into his mouth, and the tonsil shrunk to a reasonable size. In this case I found that the man had been admitted previously into the Royal Free Hospital owing to bleeding after a tooth extraction. It is, however, remarkable that the hœmorrhage is not more frequently dangerous if one considers that most of the more important branches of the carotid, anastomose in the tonsillar region, but I believe the explanation is, that only the remote and smaller branches actually enter the glands, and that if the glands alone be incised there is no reason to fear this danger.

The after treatment, when the bleeding is arrested by the tannin solution is simple, no solid or warm food should be taken for two days, and if possible the patient should remain at home, this is imperative if there is an east wind; in fact the operation should not be undertaken if there is a suspicion of an east or north-east wind, and this is the only danger to be guarded against with which I am acquainted.

The sensations of patients vary much after the operation, some complain of considerable pain, and can swallow nothing but liquids for two days or even more; others say that the throat is only a little sore, and that they can eat anything.

TONSILLITIS, CYNANCHE TONSILLARIS, or QUINSY is worthy of careful consideration as it frequently causes great suffering and prostration, is very apt to recur, and may be attended even with fatal results.

The general symptoms are fever, pain, and more or less swelling of the tonsils and palate; the disease begins by chilliness and malaise; and there is invariably constipation and a very foul tongue; the occurrence of rigors indicates suppuration. The voice is very characteristic, the patient speaking as though his mouth were filled with hot food.

On examination, a varying amount of redness and swelling of the tonsils and fauces will be apparent; these parts being at first shining and then covered with mucus or cheesy secretion, and the mouth filled with viscid saliva. There is great pain and difficulty in swallowing, though the patient is constantly impelled to make an effort to swallow the troublesome saliva; liquids frequently return through the nostrils, and there is often great pain in the Eustachian tubes and ears.

Commonly nothing can be swallowed for several days but a few spoonfuls of liquid food. The nights are sleepless, and the patient fears to sleep from a dread of impending suffocation, though actual dyspnœa is rarely present. Both glands may be affected, though this is comparatively rare, except in the follicular form. Tonsillitis is generally not considered to be contagious, but I am inclined to think that the follicular form may be epidemic and occasionally contagious. Dr. Farquharson, at the Medical Society in 1873, gave the history of a serious epidemic of contagious follicular tonsillitis at Rugby, which was only arrested by carefully isolating the cases as soon as they occurred amongst the boys.

Though arbitrary divisions in disease are to be deprecated, still I think that in tonsillitis, the inflammation occurs in three distinct situations which affect the progress of the disease and its after effects. If the inflammation occur in the cellular tissue, forming the bed of the tonsil, matter is almost certain to form; there is very great swelling, the œdema extending frequently into the soft palate and uvula, with much difficulty in swallowing, the jaws are fixed, and the tip of the finger can be hardly introduced between the teeth; the tonsil does not project into the mouth and any attempt at its removal would be futile. In this form, the neighbouring lymphatics frequently become affected and there is danger of œdema of the glottis; the cellular planes in the neck may even become involved, and I once saw a case which from pressure on the windpipe from such a condition appeared to demand tracheotomy; this operation has actually been performed for tonsillitis.

The pus usually points in the soft palate, in the pharynx or in the pillars.

When the inflammatory process occurs in the parenchyma of the gland there is also much difficulty and pain in deglutition, but there is not so much obstruction, as the surrounding parts are not so much affected, and the mouth can frequently be opened wide enough to allow of the introduction of the guillotine; the tonsil projects from between the pillars, and there is a distinct tendency to the formation of pus in the *substance* of the tonsil; nevertheless, resolution not infrequently takes place.

In the third situation the inflammation is chiefly confined to the mucous membrane lining the crypts and secreting portions of the gland, and from my observation there is rarely, in these cases, a tendency to the formation of pus, but the tonsil is covered with numerous yellow spots, which consist of a cheesy, offensive secretion exuding from the orifices of the follicles; there is also great difficulty in swallowing, but the mouth can be opened fairly well. This form of the disease is not uncommonly mistaken for Diphtheria.

Quinsy in young children is not common, but is much more dangerous than in more advanced life, as œdema of the larynx occurs much more frequently, and the internal carotid artery is so close to the tonsil that it is surprising that more fatal cases from hœmorrhage due to ulceration of the carotid walls have not been reported.

The treatment of tonsillitis is by no means in a satisfactory state, as the most varying modes of practice are in vogue, some of which are positively harmful, while others leave the patient in needless suffering. Blistering, whether by mustard, ammonia, or cantharides adds to the patient's suffering, increases the swelling about the neck, and is useless in cutting short the disease; gargles are perfectly useless and distressing. If the case be seen in the early stages, a brisk cathartic should be administered as the bowels are always constipated, and drop doses of tincture of aconite should be administered every hour. This treatment often cuts short the inflammation. Great relief is afforded by sedative inhalations of chloroform and tincture of benzoin every three or four hours, the patient sucking ice in the intervals; linseed poultices containing extract of belladonna may be applied at night. Considerable difference in practice exists with regard to the time for making an incision in the swollen tissues. I consider that incisions in follicular tonsillitis are useless, but that in the other forms, when there is obvious swelling either in the tonsil or palate, whether fluctuation is present or not, a very fine tenotomy knife passed straight through the affected part affords frequently immediate relief, both by the bleeding and by the removal of tension. After the incision, the patient at once expresses relief, and can frequently open the mouth an additional half inch or so. If pus follow the knife, the incision should be enlarged inwards; but even though no pus follow the incision it will, if already formed, almost invariably burst through the incision in the course of a few hours, with immediate relief to the patient. If several attacks of quinsy have previously occurred, and the mouth can be opened widely enough, the best practise is to remove the projecting portion with the guillotine, by which measure the abscess is opened and the chronically diseased tissue removed by *one* operation.

I find that many practitioners who have seen this done, express surprise at the operation being undertaken during the acute stage; but as a fact, the resulting bleeding is beneficial, the relief to the patient is great, and future operations are avoided. The exciting causes of quinsy are primarily cold, and tonsils which are permanently enlarged are peculiarly liable to attacks of inflammation on slight provocation, but there are people with a peculiar constitutional tendency to tonsillitis, and in adult life it will generally be found that this is an indication of a gouty or rheumatic diathesis,* especially in constantly recurring cases of follicular tonsillitis. When the diseased tonsil has been removed in one of these constitutional cases, it will be found that slight abortive attacks of inflammation may periodically recur in the stump, but without suppuration, and with absence of all the severe symptoms which previously happened.

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* My Colleague, Mr. Lennox Browne, lays great stress on this gouty tendency, and I believe he first directed my attention to it.

Much success will be met with in preventing this recurrence by carefully attending to the constitutional treatment, and by the use of Turkish baths, which latter, are of much more value in the treatment of diseases of the air passages than is generally recognised."

DISEASES OF THE UVULA.

"When considering the affections of the uvula, which have so frequently such a baneful effect on the brilliancy of the singing voice, it must be a source of regret that no thorough explanation of its functions has been discovered, as it is difficult to imagine that an organ so definite and regular in its appearances in man should exist without a purpose. Nevertheless, though the uvula appears to act at least as an adjuvant to the performance of several functions, its physiological study is much obscured by the fact that its *complete* removal—as I have several times witnessed—appears in most cases to be attended with merely negative results. The study of its development in fœtal life and amongst the lower mammalia also throws no light upon its probable uses. I have communicated with several eminent English comparative anatomists on the subject, and have been able to glean no information.

Professor Huxley writes me 'I have made no special study of the uvula and can give no information respecting it, beyond such as will be found in the ordinary text books of comparative anatomy.'

Professor Allman writes 'the uvula must be classed among organs whose uses have never yet been satisfactorily determined; it is more or less developed in the other mammalia, but I know of no observation which throws much light on the purpose it is intended to serve in the animal economy.'

The late Sir Duncan Gibb, in an interesting article communicated in the Lancet in 1872, endeavoured to prove that the uvula played an important part in deglutition and vocalisation, and I entirely agree with the facts which he adduces, but they appear to me to exclusively apply to the functions of the azygos uvulœ, and a small portion only of this undoubtedly powerful muscle appears in the uvula. The definite and remarkable shape of the uvulâ is still unaccounted for. It has been suggested that the uvula acts as a shoot or conduit for the mucous and salivary secretions, lubricating the orifices of the windpipe and gullet; this explanation may also not be unworthy of consideration.

It may be remarked here, that in some cases of destruction of the uvula by disease, there is a tendency for liquids to pass into the nostrils, but in such instances there is nearly always an encroachment on the remaining structures of the soft palate. I have also observed that in the production of the higher notes and the falsetto voice, the uvula is powerfully retracted by its muscles *into* the soft palate. With regard to the production of the falsetto, concerning which so much difference of opinion exists amongst both musicians and physiologists, I may state that I have recently had three professional singers under notice who can all produce falsetto notes with ease whilst the laryngoscopic mirror is in their mouths, which is somewhat rare, and I can assert that I have been unable to detect any appreciable difference in the appearance of the vocal cords in passing from the natural to the falsetto voice. One gentleman, an American baritone, who had rendered me great assistance in my observations both by the intelligent interest he manifests as a musician and by the great toleration he evinces under laryngoscopic examination, is so thoroughly convinced that the falsetto is produced by the soft palate, that I will quote his own words. 'No matter however hoarse I may be, from congestion of the vocal cords, to which I am subject, provided the soft palate or tonsils are not swollen, I can execute the falsetto with as much ease as if I were in a perfect state of health, and am able to make chromatic runs and trills with entire ease, though totally unable to make a perfect tone in the natural voice.'

Sir Duncan Gibb remarked that in females who possess the highest singing compass, the uvula and soft palate are relatively small, but that their muscles are capable of the most delicate and prolonged actions.

A condition of relaxation of the mucous membrane, either with or without hypertrophy of the muscular and cellular tissues, is the most common form of disease in the uvula, and this relaxation may be chronic or only occasional, depending on catarrh or on a debilitated state of health.

Its appearances vary considerably; if there is much hypertrophy of the substance of the organ, the uvula appears clubbed and thickened and is often incapable of being retracted into the soft palate; if the mucous membrane only is affected, the uvula may taper down to a fine point and look quite transparent in its lower third. In colour, the uvula may appear pale and anœmic, or on the other hand so congested as to be almost purple, with large varicose veins running over its surface.

A relaxed uvula is frequently overlooked, because at the moment of opening the mouth the patient at the same time takes an inspiration by which the soft palate is drawn upwards, causing the uvula to be retracted almost out of sight. If the patient be directed to repeatedly open and close the mouth the muscles become exhausted, and the temporary nervousness is overcome, and if the uvula is really at fault it will be seen lying on the root of the tongue, though possibly at the first glance into the mouth it was high up in the arch of the soft palate. The same effect may be produced by directing the patient not to breathe in, as he opens his mouth.

Cases are on record where the uvula has been so elongated that it could be drawn out between the incisor teeth: in such instances the mucous membrane is almost entirely in fault. It is, in my opinion, unquestionable that in some cases the uvula falls into the larynx, and this occurs most frequently at night, especially if the patient lies on the back, the result is a violent paroxysm of coughing, and considerable difficulty in obtaining sleep, and the attack is generally considered to be asthmatic in character. Some patients have the consciousness that they have as they describe it 'swallowed something,' *i. e.*, the uvula, or they recognise that the attack is always brought on by assuming certain positions. In these cases there exists, as a rule, a generally relaxed and congested condition of the mucous lining of the pharynx, larynx and bronchi.

The cough produced by a uvula which constantly rests on the base of the tongue * or which occasionally touches the lip of the epiglottis is frequently of a most harassing, and to bystanders, most irritating character, and it is not at all infrequent to find that the impression exists amongst the patient's friends that consumption is clearly indicated. It will be frequently noticed that persons who habitually indulge in stimulants, especially spirits, suffer with a congested pharynx and an enormously hypertrophied uvula, producing most distressing cough, which even under such disadvantageous circumstances, is often much relieved by an operation on the offending uvula. The voice is also in a case of long standing, hoarse, as there exists a chronic congestion of the whole of the interior of the larynx, which in an uncomplicated case frequently disappears in a manner most gratifying to the patient after the removal of the offending portion of the uvula. One must not, however, too hurriedly jump to the conclusion in a case of hoarseness, with obviously relaxed uvula, that it is the uvula which is alone in fault, as on two occasions lately, at the first glance into the mouth, I concluded that the laryngeal irritation was produced by the elongated uvula, yet the subsequent use of the laryngoscope demonstrated the existence in the one case of two and in the other of one polypus on the vocal cords. I would therefore always urge the use of the laryngoscope before assuring the patient that his troubles will be ended by an operation on the uvula. A diseased uvula is also frequently a focus † for the spread of mischief along the Eustachian tubes into the tympana, both by continuity and sympathetic irritation; that this is quite possible may be

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* The sensation that "something wants removing" is very general; and a gentleman now living near Hastings, actually in a fit of desperation, as his then medical attendant would pay no attention to the uvula, cut it off with his own hands, and was rewarded by the immediate cessation of his cough and concurrent symptoms."

The uses of the Uvula, by C. B. Garrett, M. D. *Lancet*, p. 462, 1874.

† "Irritation often spreads from the uvula to the ear, through the Eustachian tubes by continuity of surface; and I am also persuaded by extensive observation, that an irritable uvula frequently deranges the organ of hearing by purely sympathetic irritation of the ear. I have seen many cases in which tinnitus was manifestly excited in this manner."

On Throat Deafness. James Yearsley, p. 14.

proved by the fact that great pain is often felt in the ears after an operation on the uvula. The sense of smell is also sometimes impaired by the irritation produced by a diseased uvula, and obstinate morning sickness may be occasionally traced to the same cause. Professional singers who are constantly using their voices, even when the victims of catarrh, are frequently subject to a chronic relaxation of the uvula and pharynx, which ultimately has a very unpleasant effect on the quality of the voice, though they generally learn some trick of forcing their voices, which for a time relieves them of their troubles.

The instruments I find most convenient for the removal of the offending portion of the uvula are a *straight* finely toothed forceps, 7½ inches long, and a pair of curved blunt pointed scissors, longer in the handles and with a greater curve than those generally sold by instrument makers; the hand is thus entirely prevented from obstructing the view, as is apt to occur with shorter instruments. Scissors are also made with a rectangular beak, which is passed behind the uvula and which is supposed to prevent any wound of the pharynx; I have frequently operated with this instrument but fail to see the utility of the beak and in fact consider it an encumbrance. A uvulatome is also sold extensively, for which an advantage is claimed that it enables one to dispense with the use of two separate instruments, but as the uvulatome seizes the uvula, and also cuts it off by the same motion, I consider that too much is left to the instrument to perform automatically, the same objection which I have to the various complicated tonsil guillotines. Not unfrequently the uvula retracts by involuntary spasm, and thus a very inadequate amount, or, in other cases, an excessive quantity will be removed by such an instrument. The most important part of the operation is the determination of the *amount* of the uvula which ought to be removed, and this is best ascertained by gently drawing the uvula *forward* and mentally measuring the length of the organ carefully, before making the cut. The cut should be directed slightly upwards and backwards as the raw surface then points towards the nasal portion of the pharynx, and is not irritated by the passage of food. The same after treatment should be pursued as in the operation on the tonsils. The pain complained of varies much, some patients hardly feeling any at all; occasionally, considerable pain is felt in the ears for a few hours; sometimes there is an uncomfortable sensation as though there were a substance in the throat which ought to be swallowed, this may be relieved by sucking ice and marsh mallow lozenges. In many cases the operation of cutting the uvula is much more difficult to carry out than an operation on the tonsils, owing to the sensitiveness of the throat, the tendency to vomit and the spasmodic action of the muscles of the soft palate. Dr. Yearsley says, 'simple as the operation appears it is sometimes attended with considerable difficulty; and owing to the irritability of the throat, I have met with cases in which it could not be performed. In others, the slightest touch of an instrument, or even the finger upon the tongue, was sufficient to produce vomiting. In such cases it is necessary to accustom the throat to the contact of instruments for some days before the operation is attempted.'

This operation in an appropriate case, whether undertaken for the relief of some distressing symptom or for the removal of some obstruction to the singing voice is often most remarkable and beneficial in its results. It is certainly most important for a singer to know that if the uvula become permanently relaxed the voice will suffer in tone and quality, and a sensation will be produced as though the higher notes were muffled, veiled, or even extinguished. Dr. Yearsley says 'I have often known the injury to the voice and the respiration, the harassing cough of years, removed in a moment by the loss of the uvula. The operation, moreover, renders the voice clearer than before, and increases its compass. In some professional singers I have proved that the excision of the uvula has gained for the patient one, two or even three notes in the voice, and this not in the falsetto, but in the natural register.' Of the truth of this latter proposition I am thoroughly convinced and I possess the proof in the written statements of several singers on whom I have operated, and I alluded to this fact during a discussion on the subject at the Medical Society last session. In simple elongation of the uvula, dependent on obviously temporary relaxation of the part, whether resulting from a deteriorated state of health or catarrh, astringent gargles or painting with strong solutions of sulphate of copper or chloride of zinc will frequently persuade the uvula to return to its normal dimensions, though there is a great tendency to recurrence with the slightest exciting cause; many patients saying that 'their throat always troubles them if they get out of sorts.' But where hypertrophy actually exists, the uvula being both thickened and elongated, then removal of the abnormal length is the only remedy. Removal by caustics is very painful, tedious, and unsatisfactory in its results.

It is not at all uncommon to find the uvula bifid at its extremity, or the cleft may extend as far as its base; this condition constitutes the slightest form of cleft palate, and as I am not aware that it ever produces any inconvenience or alteration in the voice, no operation is required. In certain rare cases, no evidence of the rudimentary existence even, of a uvula could be discovered.*

Œdema of the uvula occasionally comes on quite suddenly from cold, without any symptoms in the tonsils or larynx, and the swollen organ may produce considerable distress; scarification gives great relief, or a portion of the uvula may be removed, care being taken to allow for shrinking, and therefore not to remove too much. Œdema of the uvula in the course of diphtheria may be a source of considerable danger to the respiration, but here removal would not be permissible, since the wound would be almost certain to form a fresh focus for diphtheric deposit and ulceration. Warty and vascular growths occur on the uvula, and sometimes occasion distressing cough; they may be easily removed with the curved scissors."

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* "Whatever the extent of fissure there is generally more or less of the hard and soft palate observable on each side, yet there are even exceptions to this rule; thus, I find reported 'two cases of *total absence* of the uvula, one in a Hindoo girl, and another in the practice of Mr. Wallace, at Bow,' and M. Ancelet refers to an example in which there was a total absence of the soft palate in a child. A patient was under my care in the hospital, aged 6, who had a congenital fissure extending through the soft palate, and involving the hard to a very slight degree, but there was *not a vestige of uvula on either side*, the soft palate being continuous on either side with the pharynx. It is further of interest to note in connection with the case, that the *child's voice was not very much impaired.*"

On Hare-lip and Cleft Palate p. 55, by Francis Mason, London, 1877.

DEAF-MUTISM.

*"DEAF-MUTISM is dependent on several different conditions; but, speaking generally, it may be said to be caused either by total or partial deafness, the result of congenital defect or of disease occurring during early life. We will take in order the various causes of mutism.

1. Of course, a child who has never heard cannot acquire language in the ordinary way, and therefore is dumb. The chief defects that have been found in the ears of congenitally mute children are a complete absence of the labyrinth; the cochlea with only one turn and a half; absence of the semicircular canals; one or two of the semicircular canals imperfect; the fenestra rotunda closed by bone.

If a completely deaf child be brought to you, you will not always find it very easy to persuade the parents that their child has never heard, or, indeed, that it does not hear a little. The point may, however, readily be put at rest in the following way: While the child's attention is taken up with some toy or the like, and you make a very loud sound, such as a whistle behind it, at the same time taking care that your shadow does not cross its field of vision, or your breath fall upon it, if it does not show some sign of hearing, such as looking round, it may be considered totally deaf. Because the child makes some labial sounds, 'Mam' and 'Pap,' its friends do not understand how these words can have been learned without they have been heard by the child. They forget, or rather they don't know, that by watching the lips, the two labials M and P are at once without any trouble learned by mutes, and that as these two words have often been repeated to the child the motion of the lips necessary to execute such sounds have been copied by it.

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* Diseases and Injuries of the Ear, by Dalby, 1873, page 206.

Mute children are too singularly susceptible to vibrations, and will turn round when any one enters a room or shuts a door, thus again giving rise to the fallacious idea that they hear, so that in practice it is well to be aware of this little difficulty.

2. It is not at all necessary that there should be a complete absence of hearing power in every case where a child has never spoken; a very moderate degree of deafness is quite enough to produce this misfortune. When it is remembered that children acquire language by hearing each word frequently repeated, and that every new word they learn is imitated imperfectly at first, and gradually the articulation is corrected after successive attempts, it will be readily understood how in the case of a child who was rather deaf, the only way in which language could be acquired in the ordinary way would be by repeating a word over and over again in a loud voice close to the ear which is possessed of partial hearing power, and correcting the articulation of the child until it was perfected. This process not having been pursued, as a natural consequence the child is dumb.

3. The next example is where a child is born with good hearing power, and loses the hearing either totally or in a great measure before it is old enough to have acquired speech. Scarlet fever and other of the exanthemata are the most common causes of this.

4. A child may have learned to talk, and at the age of 3, 4, 5, 6, or even 7, may become totally or extremely deaf; in the course of a few weeks, in the instance of a child of 3 or 4, in a few months if the child is older, it will be dumb.

The most fruitful causes of deaf-mutism induced by disease at this period of life are scarlet fever and inherited syphilis, but I have also known children to become nearly dumb when the Eustachian tubes have been obstructed very extensively and for long periods; thus you observe a moderate degree of deafness sometimes quite suffices to act in the same way as complete absence of hearing power does at others. When children are in process of becoming dumb, their articulation gets more and more indistinct, until by and by it is impossible to make out what they say, so that whenever you see a child who is at all deaf beginning to speak thickly, it is well to remember the danger which threatens, and without delay to turn your attention to the condition of the ears; for it is surprising how quickly the power of articulate speech becomes lost when it once begins to fail, and the reason of this is sufficiently obvious; the child not hearing what is said around very soon forgets the knowledge that it has not practiced itself in exercising for a long enough period to make speech a confirmed habit. The same influences which make a child in this manner dumb will cause a child to lose one language while it is acquiring another. Thus a boy or girl of 4 or 5 years of age who has been brought up in India with a native nurse and taught as a first language Hindostanee, will in six months if it is brought to England and does not hear this language spoken have completely forgotten it.

After examining a case in which the speech has been lost or not acquired in consequence of impaired hearing, the first question to determine is whether any treatment is likely to improve the hearing, and, if so, to what extent it probably will be restored; for in case of a fair extent of hearing being arrived at, no further treatment or management of the child will be required, and in the natural course of events the child will learn to talk. An interesting case is recorded by me in the 'St. George's Hospital Reports,' 1872, in which a child acquired speech in the ordinary way, became considerably deaf after scarlet fever with perforations of the tympanic membranes, rapidly lost all power of speech, and after recovering the hearing in a great measure under treatment learned to talk for the second time in her life, in the course of six weeks. The rapid way in which this child, eight years of age, acquired the power of speech, is a great contrast to the slow and tedious process pursued by the same child when very young, and was plainly due to superior development of her mental capacity. In former lectures the whole subject of treatment of the ear affections has been dwelt upon, so that for the present we will dismiss from consideration the cases in which the hearing can be benefited, and briefly discuss the management of dumb children who are either totally deaf, or partially and incurably deaf. A question of very great importance to the parents of mutes is, which is the best system by which the child or children should be educated.

You know that until very recently indeed, the plan adopted in this country has invariably been one by which children are taught to express themselves by the use of the finger alphabets (Dactylology) and manual signs, in common parlance to talk on their fingers. Mutes who have been taught on this principle, after instruction extending over a brief period are able to converse with other mutes and those who know their language, and when they have acquired facility can hold a conversation almost as quickly as can speaking persons. Another system has for many years prevailed in Germany, Holland, Austria, Sweden, and some parts of the United States of America. The finger alphabet and artificial signs by gesture are not made use of, but the children are taught to use articulate speech, and by watching the lips of others understand what is being said. This is achieved by diligent cultivation of the powers of observation and imitation. It is the duty of every medical man to make himself acquainted (if opportunity offers) as far as possible, with the results of both systems, so that when he is asked which he recommends he may be able to give an opinion on the subject.

With regard to the plan usually pursued in England I have nothing to say, as the working of it may be seen by paying a visit to any deaf and dumb institution, but of the other, as it is not so familiar to persons in this country, I have something to say, and I cannot more rapidly explain myself than by reading an extract taken from an account I have elsewhere given of this subject.*

'The so-called German system of education of mutes may be briefly described as one where deaf and dumb children are taught to understand and employ language, by observation and imitation of the articulation of others; the finger alphabet and all artificial signs being rigidly excluded.

'For this, as for any other system, it is of course necessary that the child's intellectual faculties be not more than usually deficient, and obviously where there is a cleft palate or other malformation of the organs of speech (which appears to exist in the proportion of one in one hundred mutes), it is not applicable. The age at which education commences is about seven years, and eight years are expended before the child can read from the lips of ordinary persons, and speak so as to be easily understood by them. Although artificial signs are excluded in the education, it is permitted and indeed is necessary at the very commencement, to attract the child's notice by pointing to the teacher's lips, and to various objects, in order to excite and ultimately obtain its undivided attention, as it is from the exercise of this, and from the child's inherent power of imitation, that all its future education is to be derived.

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* *Vide* "The Education of the Deaf and Dumb by means of Lip-reading and Articulation."

'To begin at the earliest lesson of a mute of seven years, who has received no sort of instruction. He is brought into a room, when a hearing person is spoken to by the teacher. The child soon notices that as the teacher's lips move, the listener turns round and looks at him, and he thus learns to have his attention directed to the lips of his instructor. Without entering at any length upon the subject of sounds and letters as taught to mutes, it will with a little consideration be seen how, though at first sight it is a difficulty to elicit proper sounds from them by placing their lips and tongue into the necessary positions, it is by no means an insurmountable one, and that a very complete alphabet of sounds may be formed, so that as the pupil progresses with the alphabet, he is taught in a short time by joining two sounds to articulate a word. As soon as this first step is accomplished, then the attention of the child being at once directed to some object or picture which represents the word pronounced, the object after a little time becomes associated in his mind with the sound which he has made to correspond to it.

'By way of illustration—one of the earliest lessons. The mouth of the child being opened, he is made to effect an expiration. This is done, firstly, by his imitating the teacher, and, secondly, by the latter exerting at the same time a little pressure on the epigastrium of the child. Thus the sound which corresponds in the phonetic alphabet to the letter *h* is evoked; and it is to be noticed, for reasons afterwards explained, that this is unattended by any vibration of the larynx. By opening the mouth widely, and making a slight noise, without the expiratory movement, the sound 'ah' for the letter *a* is evoked; this being attended by a vibratory movement of the larynx which can be felt to be communicated to the fingers pressed upon it. At first the loud inharmonious animal noises that are made in attempts at speech require to be modulated. This is effected in two or three ways. The teacher himself speaking in a low tone, calls the attention of the child to the quiet, subdued motions of his chest and of the muscles around his mouth. He tightly holds the hand of the child in his own, and by depressing it, the child learns to connect this movement with a lowering of its own voice. By placing the hand of the child on his (the teacher's) throat, and by placing his (the teacher's) hand on the child's throat, he will draw its attention to the slighter vibration of the larynx when the voice is lowered. By enforced attention of this kind, the child, as his education advances, soon learns that his progress depends on his attentively cultivating his powers of imitation, and by copying these movements produces in this way a fall in the voice.

'Suppose the child to have produced the sound for *a*. By filling out the cheeks and making a puff, the sound which corresponds to the letter *p* is elicited. Let these two last movements be carried on consecutively and the word *ape* is produced. The attention of the child is at once called to the object, a picture of, or better still, a stuffed ape. From that time forward he connects in his mind the idea of an ape with the sound which he has learned to make. Again, after making the sound for *a*, he is shown the letter written down; he then learns to write it himself, and is thus able, first, to recognize the word when spoken by his teacher; secondly, to speak it himself; thirdly, to understand its meaning; fourthly, to recognize it when written; and fifthly, to write it himself. Each of these branches of instruction, therefore, go together hand in hand. To perfect some of the sounds, it is necessary to make use sometimes of certain aids; for instance, in making the sound for the letter *p*, some children will not compress the lips sufficiently firmly, and thus they will produce the sound 'pooh' instead of 'pah.' By making the child blow away a little piece of paper for a few times, when he is making his attempt, this mistake is avoided.

'When the lips are compressed with a slow expiration and advanced, the sound corresponding to *w* in English and *ou* in French is made. The lips closed in the position for *w* are opened quickly with a puff as said before, the sound for letter *p*, or opened slowly when the sound 'bah' or that for letter *b* will follow. We have then the three consonants, *w*, *p*, and *b* of our alphabet, in which the two lips are alone employed. These for the present let us call bilabials.

'The upper incisors applied firmly to the lower lip, and quickly separated, the sound corresponding to letter *f*, or, slowly separated, the sound for *v* will be produced. These two letters, therefore, will, from their formation, be inciso-labials.

'The tongue being placed in apposition to the lower incisors, and the teeth closed, with a quick expiration, the hissing sound for the letter *s* follows. The same, with a slow expiration, will produce the sound for *z*, with the difference, that in the latter case, the child's attention is drawn to the vibratory movements of the larynx, which are absent for the letter *s*. The tongue being placed between the teeth, with a quick expiration, *th* as in the word *thin*, and with a slower expiration as in the word *thine*, is effected.

'The tongue being placed in apposition to the upper incisors, and moved quickly away, the sound for *t* is pronounced with a quick expiration, and for *d* with a slow expiration. These sounds or letters let us call inciso-lingual.

'The gutturals, such as *qu* or *k*, are sounded by expiration when the tongue is curved backwards and downwards, and this is assisted by a little pressure exercised on the child's larynx, between the two fingers of the teacher; or let the tongue be pressed back to the lower part of the mouth, and let the child be made to say the sound which he has learned before for *t*. The sound for *g* is the same as for *k*, with the difference that there is a greater and deeper movement of the larynx. The sound for *m* is made with closed lips, and expiring through the nose, while *n* is effected as follows: The teeth being firmly closed, the air is prevented from escaping between them by placing the tongue up against the upper incisors, and breathing through the nose. For the sound corresponding to *l*, the tongue is made to move up and down quickly against the hard palate, the teeth being separated about a finger's breadth. In the sound *r* the tip of the tongue is kept vibrating against the hard palate, and the vibrations of the larynx are felt to be distinct.

'To go back to the letter *a*, which, sounded *ah* as in '*far*,' is the first vowel taught. The mouth is opened, the tongue kept flat, and an expiration is made. The open mouth is then made a little smaller by bringing the corners nearer to each other, producing the sound *oo* as in hoop, and between these two comes the vowel *o*. These are the first three sounds taught in the vowels. In the sound for *e* the under jaw is pressed forward, the larynx raised a little, and *a* is attempted to be sounded, with the effect of producing *e*, or written *ea* in the child's phonetic alphabet.

> *i* is composed of and produced by *a* and *e* rapidly run into one.
> *ou* “ “ *a* “ *oo* “ “
> *oi* “ “ *o* “ *e* “ “

Lastly, the sound for *y* cannot be learned until the sounds for vowels are perfectly mastered, but it will then be found to be composed of the two sounds equivalent to *e* and *a* rapidly succeeding each other without a pause, or rather run into one. To show this, the mute, if made to pronounce with rapidity a sound written down as *eas* would articulate the word '*yes*' as used by us.

'The spelling-book of the mute, therefore, will differ in some degree from that of an ordinary child, as he will not make use of or connect in his mind the same sounds that we are accustomed to do in pronouncing the individual letters of our alphabet, but he will produce the very same word when the letters are joined together.

'To go back to the old example: *a p e* will spell *ape* for us and him alike, but each letter individually he will call by a different sound to that which we make when naming it. Strictly speaking, the mute's alphabet is more correct and less arbitrary than our own.

'The first year of the child's education is spent in reading the sounds of his alphabet and words of one syllable from the lips of the teacher and from the book, in articulating them, in writing them, and connecting the sounds he learns to produce with objects corresponding to them. It will be observed with infants and children who have the power of hearing, that the first sounds which they make are labial ones, such as sounds beginning with *m* and *p*, &c.; and these will also be found in mutes to be those most easily learned at the commencement of their education. As age advances in the one and instruction with the other, the sounds next easily learned are those made with the lips and teeth.

'It is necessary in teaching the deaf and dumb to be particular as to the way in which the expirations are made and concluded, for unless this be completely effected, the sounds will die away before they are perfectly emitted from the mouth. Indeed, one would suppose it quite likely to happen that the child might sometimes imitate exactly the motions of the lips, tongue, &c., necessary for articulation, without emitting any sound at all. This, however, practically does not occur; and more than this, the children who have had as much as two years of the education will detect the teacher or any one addressing them, if they should form the words with the lips and omit the sound. The second year's education is much the same as the first, progressing, however, from words of one syllable to words of two or three, and words where two or three consonants come before or after a vowel, as in the words *arms* or *straw*. Here the difficulty met with is that the child requires practice in repeating such words quickly, the tendency being to pronounce the consonants too separately, thus producing a sound like *ser ter aw* instead of *straw*, *per lace* instead of *place*.

'In words of two or more syllables, when the stress is to be laid on one syllable, this is accomplished by moving the child's hand quickly down as that syllable is being pronounced. In the second year the early parts of arithmetic are commenced to be taught, and it is obvious that as the education advances year by year, no matter what the subject-matter that is being learned, the practice of speaking and reading from the lips or books is at the same time continued equally for all.

'It may occur to some that the two systems of Dactylology and lip-reading might be advantageously combined, that the benefits of each might be received, and their respective disadvantages left out. Let me say, once for all, that this is found to be impossible; more than this, it is of the greatest importance to check any disposition that the children may themselves evince to combine manual signs with vocal sounds. If this is once permitted, the child soon loses the power of keeping its attention undividedly fixed on the lips of the person speaking, and from that time begins to disprove in its own diction.

'The advocates of the system of Dactylology will be found, when speaking on this subject, to declare that only a certain number of children possess sufficient intelligence to learn articulation, and as instancing this, they will mention adults who are able to converse with facility on the fingers, and at the same time read from the lips and use articulate language. In all the cases of this kind which I have met with, on rigid examination I have found that they have first learned lip-reading and articulation, and that, having become proficient in this respect, they have subsequently learned to speak on the fingers. This, of course, is quite a different case to those I am speaking of. Here the finger-talking must be looked upon in the light of an accomplishment—of a second language, or as if acquired by hearing persons. The true physiological explanation of the indubitable fact, that, if finger-talking and manual signs are attempted to be combined with articulate language before the children have learned the latter method thoroughly, they will not be able to learn articulate speech, will, I think, be found to be the following.

'If the child can make its wants known by making signs, although its attention may be called to the lips of the teacher, it will not be able to maintain its attention with sufficient perseverance and care to permit of the full development of the fine muscular sense inherent in the tongue, lips, palate, and throat, which full development is, I believe, essential in order to give the child the power of imitating with exactness and precision the movements which it is being taught.

'So far we have been considering the case of children who are totally deaf, either congenitally, or having become so before they have learned to talk. In passing, I may mention two or three somewhat different conditions. Firstly, where children have become incurably deaf before they have learned to talk; not so deaf but that they can hear moderately loud sounds, but sufficiently so to prevent their hearing enough of what is said to allow them to acquire speech; with these the little hearing which remains will prevent the harshness and want of euphony which characterizes the voice of the totally deaf mute who has been taught on this plan. Secondly, a little further degree of hearing will be of immense advantage; for besides speaking euphoniously, if a word shouted close to the ear can be understood, this will serve to correct the articulation, and the child will, of course, not take so long to learn. Indeed, the more hearing that is left, although not enough for a child to learn to speak in the ordinary way, the more quickly and better will language be acquired. Thirdly, in case of a child who has learned how to speak, and at an early age, say seven, has lost its hearing completely by scarlet fever or the like, it is well known that from the fact of its not hearing others speak it will not be tempted to make use of speech itself, will gradually depend more and more on signs, and in a short time will have lost all power of speaking. For such patients this system is invaluable, for if they are taken in hand as soon as they become deaf, they can with very little difficulty be made to learn lip-reading, and will then retain their speech, or where it is beginning to be forgotten will rapidly relearn.

'The early part of the education is in the highest degree laborious to the teacher, and, besides the perseverance required, it is actually physically hard work. To perfect the sounds made by even quite the beginners, it is important as soon as possible to teach them such sounds as represent words corresponding to some visible object, or constantly recurring sensation. The idea of the object or sensation having once become connected in the mind of the child with the motion of the lips by which he has learned to indicate it, he repeats it with great frequency and pleasure, thus giving opportunities to the teacher to correct any faults he may possess in pronunciation. Moreover, it constantly happens, and I have myself observed it when paying visits to the children undergoing this course of instruction under Mr. Van Praagh, that one child who is more advanced will correct one less so when the latter makes mistakes. And again, from the very careful and *prononcé* way in which the children enact the movements of the lips and tongue, the smallest variations in these particulars are at once noticed by their companions and immediately imitated. It results, then, that a correction from the teacher which serves for one pupil will indirectly affect the others in the class. Thus it is more advantageous than otherwise that numbers should be taught under the same roof. It must not, however, be understood from this that the separation of the mutes from speaking individuals is recommended. In fact, after the first year or two of instruction, the reverse is far the better plan; for the more the child can mix with the outside world, with its relatives and friends, the more do its observant powers become cultivated; and this end is assisted by change of persons and surrounding objects which interest it, rather than by keeping it entirely resident with its fellows. For this reason the institution of day schools seems to me to be likely to prove more beneficial, besides being less expensive, than asylums for this method of educating the deaf and dumb; the end and aim of this system being that the children, when grown up, should occupy positions of usefulness where they will receive the ideas of others and communicate their own to ordinary men and women, rather than that they, like those who only talk on their fingers, should have occupations where their social intercourse is limited to those similarly affected as themselves.

'Among the advantages which this method of teaching appears to possess over that of speaking by the use of the fingers and artificial signs, one of the chief is the following: That when the children have acquired the power of talking by the dumb alphabet, however perfectly, and go out into the world, they are still deprived of all intercourse with their fellow-creatures, excepting in those very rare instances where they happen to meet with those who are able to converse the same way as themselves, the proportion of such persons in ordinary life being so extremely small that for the sake of argument they might almost be put out of the question; or again, on the supposition that a mute could only acquire the power of *reading* from the lips of others without being able himself to articulate, and thus convey his ideas to others, it becomes a question whether he would not, although he had to reply to everything by writing, be a more useful member of a community composed of ordinary speaking individuals, than a mute who could only receive and convey his ideas to those similarly situated as himself, or be dependent for conversation on a chance meeting with some one who had acquired his peculiar language. If such a proposition bears a moment's reflection, it must be apparent how very considerable must be the advantage of that mute who possesses not only the power of receiving information conveyed in language familiar to all, but also of replying in the same manner. Both of these faculties, however, are, in the system under consideration, so intimately combined, that the one naturally follows the other.

'In the early part of the education this method, undoubtedly, is more slow than the other in the facility which it gives for conversing, either by the child or to the child, but this, I submit, ought to possess very little weight when compared with the results attained at the end of the course of instruction.

'The condition that the child is placed in with regard to its importance as a member of society when it leaves school, and the careers of usefulness that are then open to it, should, to my mind, be the chief points which ought to be kept in view when comparing the respective merits of the two systems. Of what importance is it if, at ten years of age, a child can talk well with its fellows—well with those who have learned its language—if, at fifteen years, it still only possesses the power of communication with the few, while its companion (brother or sister, it may be) of the same age, who has been taught on the other plan, converses by means of and understands the language of the many? Looked at in this light, the position of the two children hardly admit of comparison. With regard to the ultimate chances of success with any child of ordinary intellectual powers, M. Saegert, the Inspector-General of the Education of Deaf Mutes in Prussia, in his report of 1856, says: 'Ninety-nine per cent. of deaf mutes have the organs of speech normal; they will speak if they have good sight and touch; the greater or less probability of success depends solely (*uniquement*) on the greater or less capacity of the master.'"

TOYNBEE'S TABLE OF THE CONDITION OF THE EAR IN THIRTY-SIX DISSECTIONS OF DEAF-MUTES.

Meatus Externus.	Membrana Tympani.	Tympanum.	Labyrinth.	Nerve.	Name of Observer.
Absent.	. . .*	. . .	. . .	As soft as mucus.	Itard.
Absent.	. . .	. . .	. . .	. . .	Fabricius.
Absent.	. . .	. . .	. . .	. . .	Do.
. . .	. . .	. . .	. . .	. . .	Itard.
. . .	Destroyed.	Containing vegetations from the mucous membrane; ossicles absent.	. . .	. . .	Do.
. . .	Do.	Do.	. . .	. . .	Do.
. . .	Partially destroyed.	Containing scrofulous matter.	. . .	. . .	Mr. Cock.
. . .	Do.	. . .	. . .	. . .	Do.
. . .	Do	. . .	. . .	. . .	Do.
. . .	. . .	Containing calcareous secretions.	. . .	. . .	Itard.
. . .	. . .	Full of gelatinous matter.	Full of gelatinous matter.	. .	Do.
. . .	. . .	Containing a yellow fluid.	. . .	Harder than natural.	Rosenthal.
. . .	. . .	Anchylosis of stapes to fenestra ovalis.	. . .	. . .	Valsalva.
. . .	. . .	All the ossicles wanting.	. . .	. . .	Reimarus.
. . .	. . .	. . .	Vestibule full of caseous matter.	. . .	Dr. Haighton.
. . .	. . .	. . .	Cochlea consisting of only one turn and a half.	. . .	Mundini.
. . .	. . . . .	. . .	Vestibule, cochlea, and semicircular canals absent.	. . .	Meckel.
. . .	. . .	. . .	Semicircular canals wanting.	. . .	Murer.

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* Where no entry is made, it is to be assumed that the part of the organ was in a healthy state.

Meatus. Externus.	Membrana Tympani.	Tympanum.	Labyrinth.	Nerve.	Name of Observer.
. . .	Partially destroyed.	All the ossicles wanting.	Two of the semicircular canals imperfect.	. . .	Mr. Cock.
. . .	. . .	. . .	Do.	. . .	Do.
. . .	. . .	. . .	. . .	Atrophied.	Sylvius.
. . .	. . .	. . .	. . .	Indurated.	Arneman.
. . .	. . .	. . .	. . .	Wanting.	Morgagni.
. . .	. . .	. . .	Fenestra rotunda closed by bone in each ear.	. . .	Mr. Cock.
. . .	. . .	. . .	One semicircular canal incomplete in one ear only: the other ear healthy.	. . .	Dr. Thurman.
. . .	. . .	. . .	Aquæductus vestibuli very large.	. . .	Dalrymple.
. . .	. . .	. . .	. . .	Very Hard.	Rosenthal.
. . .	. . .	. . .	Semicircular canals absent in one ear.	. . .	Murer.
. .	. . .	. . .	Filled with caseous matter.	Half its usual size.	Dr. Haighton.
. . .	. . .	. . .	. . .	Atrophied.	Hoffman.
. . .	. . .	. . .	. . .	Compressed by a tumor.	Duverney.
. . .	. . .	. . .	A portion of one of the membranous semicircular canals filled with otoconie.	. . .	Author.
. . .	. . .	. . .	The superior and posterior semicircular canals incomplete in right ear; the superior incomplete in the left ear.	. . .	Do.
. . .	. . .	. . .	Membranous semicircular canals absent.	. . .	Do.
. . .	. . .	. . .	. . .	. . .	Do.
. . .	Destroyed.	Mucous membrane thick.	Lamina spiralis near the vestibule filling the scala tympani.	Otoconie obstructing the canals.	Do.

PART X.

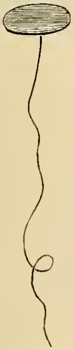
ARTIFICIAL EAR-DRUMS.

ARTIFICIAL MEMBRANES,

COMMONLY CALLED EAR-DRUMS.

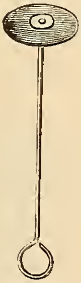
The annexed cuts represent the most useful and generally employed membranes. They should only be employed in cases of perforation, or where the drum-head is entirely destroyed. In some rare cases these appliances have been found of practical utility, but most generally patients feel better and hear better without them.

Fig. 34.



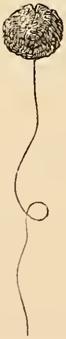
Toynbee's tympanum.

Fig. 35.



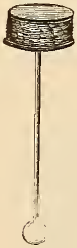
Toynbee's tympanum.

Fig. 36.



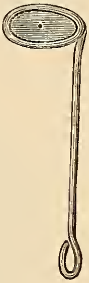
Yearsley's tympanum.

Fig. 37.



Field's tympanum.

Fig. 38.



Turnbull's tympanum.

In a communication on a new artificial membrane in the "Philadelphia Medical and Surgical Reporter," December, 1876, Dr. Turnbull makes the following observations. His membrane is shown in Fig. 38.

"*There are a few practical hints which are well to be remembered when artificial membranes are employed.* In introducing the plug of cotton wool, always moisten it with water, glycerine, or a weak solution of sulphate of zinc in water. The use of a small pair of tweezers, or small forceps, assists the surgeon or patient to place the cotton in the right place. One or two trials may be necessary before the exact spot is found. A disc of rubber or the plug of cotton wool is not, like the new artificial drum, susceptible to vibrations of sound. In applying the new membrane, we must have it made of the proper size. Before introducing, moisten the drum portion only, and carefully, with warm water and glycerine, by means of a brush, and then press it gently down the meatus; when it has arrived in the right place, there is generally a little click, from the escape of the compressed air. No force must be employed in the introduction, and we must be guided by the sensations of the patient as to the hearing being improved or not. The pledget of wool or new artificial membrane should not be so large as to entirely fill up the meatus, or perforation. An open space should be left between the wool and the walls of the meatus for sound to pass to the tympanum. The cotton wool or artificial membrane should be taken out at night. If there is any odour or pus on either side, it must be washed off; and in the case of the cotton, it had better be renewed with fresh material. The artificial membrane must be covered from extreme heat, dust, and very dry air. If granulations are found on the surface of the middle ear, projecting through the perforation, these must be removed by the use of a small portion of powdered sulphate of copper on a brush, or by dipping a long camel's-hair brush in water, and applying it to a crystal of sulphate of copper, and then to the granulations, after wiping out any pus or adherent mucus. If the bone is not involved, and these granulations cover the whole surface of the perforated membrane, a strong liquor plumbi, or solution of sulphate of zinc, can be employed by the patient at night, and applied after cleansing, by means of 'Clarke's douche.' This application can also be performed with a long brush, passed well into the meatus, from time to time, until the surface becomes healthy. Another important point in the treatment is to relieve any obstruction of the Eustachian tubes, either by Politzer's method or with the catheter."

THE AUDIPHONE.

The audiphone is an instrument invented by Richard S. Rhodes, of Chicago. It is made of hard rubber, in the shape of a fan, and is intended to convey sounds to the auditory nerve through the medium of the teeth. The external ear has nothing whatever to do in hearing with this instrument, which is represented in Figs. 39, 40 and 41.

When adjusted for hearing it is in suitable tension as per Fig. 39, and the upper edge is pressed slightly against one or more of the upper teeth, see Fig. 40.

Fig. 39.

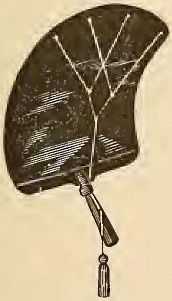


Fig. 40.

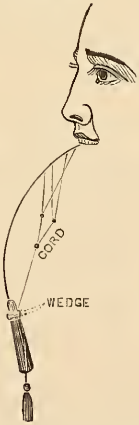
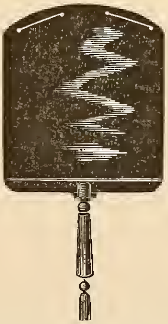


Fig. 41.



Much has been claimed by the public press for the merits of this instrument. As the number of people deprived of the function of hearing is very large; it is but natural that any promise of relief, by any means obtainable by such afflicted, would receive their earnest attention and inquiries, and if found practical would be regarded by them a great boon.

In order to test the merits of this instrument, I have put myself to quite considerable expense and inconvenience, and even delayed the issue of this book that I might give its readers correct and reliable information on this subject *from my personal knowledge, obtained by a carefvl and impartial test of the instrument in a number of cases at my office.* These cases, it will be observed from their history, have been judiciously selected for this purpose, and the results are given as follows:

CASE I.

Deafness from Aural Catarrh, fifteen years' standing.—Mrs. H., aged 73, gradually lost her hearing fifteen years ago from aural catarrh. Deaf to all sounds in right ear. Left ear deaf to tick of watch, but hears vibrations of tuning-fork close by. Tuning-fork heard equally well on both sides when placed upon the forehead, but heard more distinctly in right ear when placed on the teeth. Can hear and understand words when spoken loudly a few inches from left ear, but cannot distinguish sounds at a distance. Hears ordinary conversation quite well with the aid of the audiphone, even at a distance of 22 feet, notwithstanding she wears artificial teeth.

CASE II.

Deafness from Scarlet Fever, sixteen years' standing.—W. M., aged 18, deaf from scarlet fever since two years of age, both drumheads entirely destroyed by chronic suppuration of the middle ear. Deaf to ordinary conversation. Hears and understands when loudly spoken to close by. Hears much better with the audiphone. Hears fairly well with this instrument 20 feet or more away.

CASE III.

Deafness from Explosion of a Shell.—Mr. K., aged 47, resident of this city, lost his hearing from an explosion of a shell during an engagement in the late war. Both drum-heads are completely destroyed. Is quite deaf to the voice and all ordinary sounds. Can distinguish words when spoken *very* loudly, within six inches of his ear. Tuning-fork not plainly heard on his head, but more plainly on his teeth. Told me he had not heard the sound of any bell since 1864, when he received the injury. This statement seemed incredible, yet I regarded him a truthful man. I immediately obtained an ordinary sized dinner bell and rang it as loudly as possible by the side of his head, but he said he could hear no sound, but that he could feel the vibrations. I then handed him one of Mr. R. S. Rhodes' audiphones (A No. 702), and directed him how to use the same, placing myself some five feet away. I then again rang the bell and gradually approached him, and when about three feet away he expressed great joy at hearing the natural ringing sound. He also said "I can hear you talk and understand first-rate what you say when I have this instrument against my teeth. I then placed myself at a distance of twenty feet from him and spoke in an ordinary tone of voice, asking him several questions, and he answered them all correctly. He then said "I find I need not talk so loud as I hear very plainly what I myself say." Regarding this test very thorough, as well as very satisfactory in its results, I then took a seat some five feet from him and engaged in a conversation with him, and in a rather low tone of voice, but still he understood every word. Here I may congratulate Mr. Rhodes on the success of his invention, and my patient on his good fortune in deriving such signal benefit from the same.

CASE IV.

Deaf–Mutism caused by Cerebro-Spinal Meningitis.—J. S., aged 10, deaf since three years of age, from the effects of cerebro-spinal menengitis, and having been deprived of hearing so early in life is also dumb. On applying the tuning-fork on his head and teeth, he intimated he could hear. I then applied the audiphone to his teeth, and he seemed to hear when spoken to. I then asked him to repeat the sound I made; being a bright boy and taking much interest in his examination, I had no difficulty in getting him try to repeat any sound I made. Thinking it likely he only followed the motion of my lips or mouth, I had his eyes closed and then repeated the sounds, which he as promptly endeavored to imitate, some even remarkably correct—leaving no doubt in my mind as to his hearing with the audiphone.

REMARKS.

The above cases were not consecutive, but fairly represent the result in a number of cases examined. I feel it my duty to say that I have met with several cases in which the audiphone did not give entire satisfactory results, but I think the failures may very readily be accounted for in each case. One in that of a lady aged 68, of catarrhal deafness, the failure was altogether owing to the looseness of her artificial teeth, and in others to various causes plainly perceptible.

I may also mention here that in all cases examined, other instruments of ancient and recent invention were also tested or tried, but in no instance save one was any found as effectual as the audiphone; I refer to the case of the lady with the loose artificial teeth. In this case the ordinary conversation tube was found the only available aid.

CONCLUSION.

Having carefully and impartially tested the merits of the audiphone as a means for aiding the deaf to hear, it affords me very great pleasure to say, that in my opinion, it is the best instrument for this purpose known to the science of otology.

GLOSSARY.

A

Aberration. To wander from.

Abnormal. Irregular; not conformed to rule.

Abrasion. A scratch or superficial excoriation of the skin or mucous membrane.

Abscission. Excision or cutting out of a part.

Arscess. A collection of pus in a cavity, the result of a morbid process.

Absorbent. Any substance which absorbs liquids, as sponge, &c.

Acid. Sharp; sour.

Acid Carbolic. An acid obtained from coal-tar oil by distillation and purification.

Acid Chromic. An article obtained by mixing 100 measures of a cold saturated solution of bichromate of potassa with 150 measures of sulphuric acid, and allowing the mixture to cool.

Acid Nitrate of Mercury. Acid solution of nitrate of mercury.

Acid Nitric. One of the five compounds formed between nitrogen and oxygen; a powerful escharotic.

Acid Tannic. An acid obtained from Nut-galls.

Aconite. Monkshood, a plant of the buttercup family; a powerful nervous sedative and anodyne.

Acoustic. That which belongs to the ear.

Acute. A disease which, with a certain degree of severity, has a rapid progress and short duration. The antithesis of *acute* is chronic.

Aqua Rosæ. Rose water.

Ailment. Indisposition; morbid affection of the body.

Alcohol Dilutum. Diluted alcohol; proof-spirit.

Ammonia Muriate. A saline concrete formed by the combination of muriatic acid with ammonia.

Ampulla. A membranous bag, shaped like a leathern bottle.

Anchylosis. Stiff joint; an affection in which there is great difficulty or even impossibility of moving a diarthroidal articulation.

Anæmia. Privation of blood; the opposite to plethora. It is characterized by every sign of debility.

Anastomosis. Communication between two vessels.

Anti-helix. An eminence on the cartilage of the ear, in front of the helix.

Antiphlogistic. Opposite to inflammation.

Aperient. A medicine which gently opens the bowels.

Aquatic. Pertaining to or inhabiting water.

Aqueduct. A canal.

Argenti Nitras. Nitrate of silver. It is kept either fused or in crystals.

Articulate. To unite with ligaments.

Aspergillus. A vegetable parasite or fungus; a mould.

Aspirator. An apparatus for passing air through liquids.

Astringent. A medicine which has the property of constringing the organic textures.

Atrophy. Defective nutrition; morbid diminution of a part.

Auditory. That which relates to hearing.

Auricle. The outer ear.

Aurilave. An instrument intended for cleaning the the ear. It is harmful and should never be used.

B

Barometric. Pertaining or relating to the barometer.

Beetle. An insect of the order *coleoptera*, characterized by having four wings.

Bicarbonate of Soda. A mild preparation of soda, has the general properties of the carbonate, but is less irritating.

Bromide of Potassium. A nervous sedative.

Brevis. Short.

Bregma. The top of the head.

C

CALCAREOUS.	Containing lime.
CALIBRE.	The diameter of a round body or tube.
CAPILLARY.	Hair-like; small.
CANCROID.	That which assumes a cancerous appearance.
CARIES.	An ulceration of bone.
CARTILAGE.	A solid part of the animal body of a medium consistence between bone and ligament.
CATARRH.	A discharge of fluid from the mucous membrane.
CATHETER.	A hollow tube. (See Fig. 17, page 102.)
CAUSTIC.	A substance which burns living tissue.
CAUTERIZE.	To burn with caustic.
CEREBELLUM.	The little brain, or that part of the medulary mass which fills the occipital fossæ below the tentorium.
CEREBRUM.	The brain.
CEREBRETIS.	Inflammation of the brain.
CERATE PLUMBI SUBACETATIS.	Goulard's cerate; cerate of subacetate of lead.
CERUMEN.	Ear-wax.
CHIMERICAL.	Merely immaginary; fanciful, fantastic.
CHORDA TYMPANI.	Tympanic or drum-chord.
CHRONIC.	Of long duration.
CIGARETTE.	A little fine tobacco rolled in paper for smoking.
CICATRIX.	A *scar* which takes place at the surface of a wound.
CIRCUMSCRIBED.	Distinctly separated or bounded.
CLINIC.	Examination of patients and teaching at the bedside in hospital or at college.
COCHLEA.	The most anterior of the three cavities which constitute the labyrinth.
CONCUSSION.	A shaking together.
CONGESTION.	An accumulation of blood in an organ or part.
CONCHA.	The largest and deepest hollow of the auricle.
CONIUM.	Common or poison hemlock.
CORNEA.	The transparent coat of anterior part of the eye.
CRURA.	Apart like a leg.

D

DERMIS.	The skin.
DIAGNOSIS.	Distinguishing one disease from another.

Diathesis. Predisposition to certain diseases rather than to others.

Diffuse. In no well-defined limits; not circumscribed.

Dura Mater. Outer membrane of the brain.

Douche. An instrument for irrigating the nasal passages; a shower of fluid; also used in connection with air, an air-douche.

Dyscrasia. A morbid condition of the blood, producing a diseased habit.

Dyspepsia. A disturbed state of the functions of the stomach.

Dyspnœa. Short breath; difficulty of breathing.

E

Eczema. An eruption of small vesicles on various parts of the skin, giving off a watery discharge which stiffens linen.

Embrocation. A fluid application to be rubbed on any part of the body.

Endolymph. The fluid contained in the membranous labyrinth of the ear.

Enuncliation. Dissecting out tumors without cutting them.

Epidermis. The cuticle or scarf-skin of the body.

Epithelium. The thin layer of epidermis which covers the parts deprived of *derma*, as the nipple, &c.

Epitomize. To shorten or abridge.

Eustachian Tube. So called from its discoverer, Eustachius. It is partly bony and partly cartilaginous, extending from the cavity of the tympanum to the upper part of the pharynx.

Exanthemata. The eruptive fevers.

Excise. To cut out or off.

Excoriation. A slight wound, which removes only the skin.

Exostosis. A bony tumor.

Exudation. The act of exuding or sweating; a discharge of humors.

F

Fascia. The aponeurotic expansions of muscles which bind parts together.

Faradization. Electricity by induction.

Farina. Meal.

Farinaceous. Having the nature or appearance of farina.

Fauces. The opening from mouth to pharynx.

Fenestra. A window. Anatomists have given this name to two apertures (openings) situate in the inner parities of the cavity of the tympanum or drum of the ear.

Fibro-cartilage. An organic tissue, partaking of the nature of the fibrous tissue, and of that of cartilage.

Fossa. A cavity whose opening is larger than its base.

Fowler's Solution. A preparation of arsenious acid, bicarbonate of potassa, compound spirit of lavender and distilled water.

Fracture. A break; a solution of continuity.

Furuncle. A boil.

G

Galvanism. Current of electricity; called after Galvani.

Gentian. The root of Gentiana lutea, possessing in a high degree the tonic powers which characterize the simple bitters.

Glycerine. A principal of oils and fats, having a great affinity for water.

Granulation. A grain. Granulations are the reddish, conical, flesh-like shoots, which form at the surface of suppurating wounds and ulcers.

Grave. Of importance; serious.

Guaiacum. The wood of Guaiacum officinale, U. S. The resin, Guaiaci Resina, and the wood Guaiaci lignum, are both used in medicine. Guaiacum is stimulant and diaphoretic; and in large doses, purgative.

H

Hæmatomia. A blood tumor.

Hallucination. A morbid error in one or more of the senses.

Histology. The minute anatomy of the tissues.

Helix. The rim of the auricle of the ear.

Hygiene. Relating to the preservation of health.

Hydrargyrum. Mercury.

Hypertrophy. Enlargement of an organ or part.

Hyperæmia. A more than natural amount of blood in the capillaries.

Hyoscyamus. Henbane. Hyoscyamus is narcotic, anodyne, anti-spasmodic, and slightly stimulant. It is used as a substitute for opium.

HYPNOTIC. A medicine which causes sleep.

HYPEROSTOSIS. Exostosis.

HYPOCHONDRIAC. One laboring under hypochondriasis; hipped.

I

IDIOPATHIC. Pertaining to a disease not preceded and occasioned by any other disease.

IMPERVIOUS. Not admitting of entrance or passage through.

IMPULSE of the heart; stroke of the heart against the chest.

INCISE. To cut.

INCUS. One of the little bones of the ear.

INFILTRATE. Entered by the pores.

INFLAMMATION. A redness, heat and swelling, with morbid sensibility of a part.

INFLATE. To blow up; to distend.

INFLUENZA. An epidemic catarrh.

INSPISSATE. To thicken.

IODINE. An element found in sea-plants.

IODIDE OF POTASSIUM. A preparation of iodine and potassa, much used as an alterative medicine in the treatment of various constitutional diseases.

J

JUDICIOUS. Prudent.

L

LABYRINTH. The internal ear.

LABARRAQUE'S SOLUTION. Solution of chloride of soda; a powerful disinfectant, especially with infectious diseases.

LAMINÆ. A thin plate or layer.

LARVA. The *larve*, *grub*, or vermiform condition of an insect.

LAXATOR TYMPANI. A muscle which relaxes the membrana tympani.

LIGAMENTS. Bundles of fibrous tissue uniting bones.

LONGITUDINAL. Running lengthwise.

LOTION. A liquid preparation for washing some part of the body.

LUSTROUS. Bright.

M

MALINGER. To feign illness, or to protract disease to avoid duty.

MALLEUS. *Hammer*, the most external of the bones of the middle ear.

Manubrium. The handle of anything.

Mastoid. Shaped like a nipple.

Meatus. A passage.

Membrana Tympani. Drum-membrane.

Menstruum. Solvent.

Meningitis. Inflammation of the meninges or membranes of the brain.

Microscope. An instrument magnifying objects.

Millimetre. A French lineal measure.

Mobility. That can be moved.

Modiolus. The axis of the cochlea of middle ear.

Molecule. A minute portion of any body.

Mucus. A substance analogous to vegetable mucilage.

N

Natatorial. Inclined or adapted to swim.

Narcotic. A substance which has the property of stupefying.

Nitrate of Silver. Caustic, prepared from silver with nitric acid.

Necrosis. The death of bone, or of a portion of a bone.

Neuralgia. A non-inflammatory pain in a nerve. All varieties of neuralgia are obstinate, not yielding readily to treatment.

Normal. Ordinary.

O

Objective. Outward; external.

Occlusion. A closure.

Opaque. Dark.

Orbicular. Spherical; circular.

Oscillation. A moving backward and forward; vibration.

Ossicles. Small bones.

Osseous. Bony.

Otitis. General inflammation of the ear.

Otorrhœa. Purulent discharge from the ear.

P

Papula. A pimple.

Paralysis. Part or complete loss of voluntary motions, and sometimes of sensation in one or more parts of the body.

Paracentisis. The operation of puncturing or *tapping* to evacuate the collected fluid.

Pathology. The science which treats of the nature and cause of disease.

Perforate. The act of boring or piercing through.

Permanganate of Potassa. A powerful disinfectant, ranking among the most efficient agents, and by some considered superior to all others. It is used also very successfully in the treatment of fetid discharges from the mucous membrane in ozæna, otorrhœa, &c.

Periosteum. The membrane which surrounds the bones.

Periostitis. Inflammation of the membrane which surrounds the bones.

Peripheric. Pertaining to the circumference or border or edge.

Perilymph. The lymph in the labyrinth of the ear.

Pharynx. The part of alimentary canal from mouth to œsophagus.

Physical. Pertaining to nature or material.

Physiognomy. The science of determining character from the features.

Physiology. The science which treats of the functions of animals or vegetables, in health.

Pia Mater. A very delicate membrane which covers the brain immediately.

Pinna. Pavilion of the ear.

Plexus. A network of blood-vessels or nerves.

Plumbi Acetas. Acetate of lead; sugar of lead. A powerful astringent and sedative.

Pneumogastric. Pertaining to the lungs and stomach.

Polypus. A name given to tumors, which occur in mucous membranes especially.

Portio Dura. Facial nerve.

Portio Mollis. Auditory nerve.

Precipitate. To deposit at the bottom from a liquid.

Primary. First in order of time or development; original.

Processus Brevis. Short process.

Prognosis. A judgment formed by the physician regarding the future progress and termination of any disease.

Purulent. Having the nature of pus.

Pus. A secretion from inflamed textures.

Pyæmia. Infection of blood with pus.

Q

Quassia. A West India tree from which is obtained the Lignum Quassia (Ph. U. S.). It is an intensely durable bitter, employed as a tonic and stomachic.

Quinine. An alkaline, uncrystallizable substance. It is obtained from different cinchonas, but chiefly from the yellow. It forms, with acids, salts that are in general soluble, chief among which in use is the sulphate.

Quotidian. That which takes place every day, as quotidian ague.

R

Rarefaction. The process of causing a substance to be less dense.

Receptacle. That into which anything is received.

Reflex. Directed back.

Reverberatory. Returning or driving back.

Rotundus. Round.

S

Sacciform. Formed like a sac.

Saculus. A little sac.

Scala. A ladder.

Scrofula. A state of the system characterized by indolent, glandular tumors, chiefly in the neck.

Sebaceous. That which has the nature of suet.

Sedatives. Medicines which directly depress the vital forces.

Sequestrum. The portion of bone, in necrosis, which is dead, and separated from the living bone.

Sonorous. Loud.

Speculum. An instrument for dilating and assisting the examination of parts.

Spontaneous. Occurring without any apparent cause.

Soda Bicarbonas. See Bicarbonate of Soda.

Stapedius. A muscle of the middle ear.

Stapes. A *stirrup*; one of the little bones of the ear.

Strumous. Scrofulous. See Scrofula.

Strychnine. An alkaloid obtained from nux vomica. A medicine of great power. Very great care should always be observed in its administration.

Styloid. Shaped like a style or pen.

Subjective. Pertaining to self.

T

Tannic Acid. See Acid Tannic.

Tensor Tympani. A muscle of the middle ear.

Tertian Fever. An intermittent whose paroxysms recur every third day.

Therapeutics. The treatment of disease.

Tinnitus Aurium. See page 293.

Toxic. Poisonous.

Tractable. Capable of being easily led, taught or managed.

Trachea. A cylindrical, fibro-cartilaginous and membranous tube, extending from the larynx to the *bronchia.*

Translucent. Transparent; clear.

Transparent. Admitting the passage of light.

Traumatic. Anything relating to a wound.

U

Umbo. Elbow; the boss or protuberant part of a shield.

Unctuous. Resembling oil or grease.

Unilateral. One-sided.

Utricle. A little sac.

V

Valvular. Containing valves.

Vascular. Pertaining to blood and blood-vessels.

Vibration. Regular, reciprocal motion of a suspended body.

Vertex. Top; summit; the crown of the head.

Vertical. Situated at the vertex or highest point; upright; plumb.

Vertigo. Dizziness.

Vesicles. Small blisters.

Vestibule. Space in the internal ear.

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